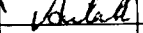
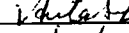


	भारत हेवी इलेक्ट्रीकल लिमिटेड BHARAT HEAVY ELECTRICALS LIMITED पारेषण व्यापार अभियांत्रिकी प्रबंधन (TBEM) नोएडा / TBG, NOIDA						
	DOCUMENT No.	TB-375-316-006	Rev 00	Prepared	Checked	Appd	
	TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	MM	AS	AS	
	ILLUMINATION SYTEM	SIGN	  				
		DATE	30.07.16				
		GROUP	TBEM				
		W.O. No	84004				
CUSTOMER/CONSULTANT	Gujarat State Electricity Corporation Limited, Vadodara, Gujarat/ Development Consultants Pvt. Ltd., Kolkata						
COPYRIGHT & CONFIDENTIAL The information in this document is the property of BHARAT HEAVY ELECTRICALS LIMITED This must not be used directly or indirectly in anyway detrimental to the interest of the company.	PROJECTS	400kV Switchyard Extension and 400kV GIS for 1x800 MW for Wanakbori Thermal Power Station Extn. Unit-8					
	<u>Contents:</u>						
	Section No.	Description				No of Pages	
	SECTION-1	SCOPE, SPECIFIC TECHNICAL REQUIREMENTS and QUANTITIES Drawings				9+2 7	
	SECTION-2	EQUIPMENT SPECIFICATION				1+38+44+20	
	SECTION-3	PROJECT DETAILS AND GENERAL SPECIFICATION				37+2	
	SECTION-4	GUARANTEED TECHNICAL PARTICULARS				1+17	
	SECTION-5	CHECKLIST				2 + 2	
Offers without checklist will not be evaluated							
	Rev	Date	Altered	Checked	Approved		
	Distribution	To					
Copies							

SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE:

- 1.0.1 This technical specification covers the requirements of design, manufacture, testing at works, packing, dispatch, unloading at site, storage, erection, testing & commissioning of complete Illumination and associated electrical auxiliary system, complete with accessories. No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-A.

1.1.0

Name of Customer : Gujarat State Electricity Corporation Limited, Vadodara, Gujarat
Name of Project : 400kV Switchyard (extn.) & 400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8
Name of Consultant: Development Consultants Pvt. Ltd., Kolkata

- 1.1.1 **The Contract shall be on Bill of Quantity basis for the package. In case of change in scope after award of the contract, the additions/ deletions to the scope shall be as per the breakup unit rates for all the equipment and services furnished by the bidder in his offer. The Contractor shall be responsible for the design and verification of the Illumination system, demonstration of lux levels and other criteria at site.**

- 1.1.2 **After placement of order, the bidder has to design the system as per relevant standard/codes to the satisfaction of BHEL/GSECL.**

- 1.1.3 It is not the intent to specify herein all the details of design and manufacturing. The equipment and the system shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to Purchaser/Owner, who will interpret the meaning of drawings and specifications and shall be entitled to reject material, which in his judgment is not in full accordance herewith.

- 1.1.4 The Bidder shall have deemed to have understood completely all the Tender drawings and documents and quoted accordingly.

- 1.1.5 It is the responsibility of the successful Bidder to obtain necessary approval/clearance from statutory organizations wherever applicable for the equipment/systems under the scope specified.

- 1.1.6 The term "Owner" appearing in this specification shall refer to ultimate customer, the term "Purchaser" shall refer to BHEL and the term "Contractor" shall refer to the successful Bidder.

The specification comprise of following sections:

- Section-1: Scope, specific technical requirements & Bill of Quantities.
Section-2: Equipment specification under scope of supplies.
Section-3: General technical requirements for all equipments under the project.

Section-4: Equipment Data Sheet

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.2 ILLUMINATION & SMALL POWER SYSTEM REQUIREMENT FOR VARIOUS AREAS:

The Illumination System shall be provided for the following areas:

- i) GIS Building
- ii) GIS control room building
- iii) AIS control room building Extension
- iv) Outdoor 400kV GIS yard
- v) Outdoor 400kV Extension yard

1.2.1 DESIGN CRITERIA FOR ILLUMINATION SYSTEM:

The illumination System shall comprise of:

- ☐ Normal AC lighting
- ☐ Emergency AC Lighting
- ☐ 220V DC emergency Lighting
- ☐ Portable emergency lighting

1.2.2 The average Illumination levels to be guaranteed are as below :

	Desired Lux Level (Lux)
Control Room	400
Battery Room	200
Staircase, Corridor, toilets	70
Office / staff room/conference room	300
Cable Vault	70
GIS Hall	200
Near GIS local control panel	300
Outdoor switchyard general	20
Outdoor operating area	50
Main roads	20

1.2.3 Reference drawings:

Sl. No.	BHEL Drg. No.	Drawing Title
1.	TB-3-375-316-068	Conceptual control room building layout- Extn
2.	TB-3-375-316-068A	Conceptual control room building layout- GIS
3.	TB-3-375-316-095	Conceptual layout- GIS building
4.	TB-3-375-510-060	Layout Plan and Section drawing of 400kV Switchyard Extension

Sl. No.	BHEL Drg. No.	Drawing Title
5.	TB-0-375-316-002	Layout Plan and Section drawing of 400kV Switchyard for GIS
6.	TB-2-375-316-064	Single line diagram of LT AC/DC DB of 400kV Switchyard Extension
7.	TB-3-375-316-006	Single line diagram of LT AC/DC DB of 400kV for GIS

1.2.4 Detailed lighting design calculations shall be submitted by supplier for approval of BHEL / ultimate customer.

1.2.5 The maintenance factors to be considered in design are :

Control Room	0.75
Switchgear/MCC Room	0.65
General indoor area	0.60
Dusty Area	0.55

Utilization factor

Clear areas such as switchgear room/control room etc. =70 % ceiling,
50 % wall, 10 % floor.
Working plane - At Building floor level.

1.2.6 The minimum lux level to average lux level ratio should not be less than 0.3

1.2.7 A.C. emergency lighting fixture will account for 20% of the total lighting Fixtures provided in the above mentioned area. In main control room, 30% emergency lighting shall be provided.

1.2.8 Lighting level by DC emergency lighting will be provided to meet functional / operational requirements. DC fixtures will be located at strategic locations.

1.2.9 In an area, the lighting fixtures shall be arranged in different phase / LPs such that even in case one lighting panel is faulty complete lighting is not affected. In case of any location the lighting shall be arranged from all three phases for normal as well as normal/emergency supply.

1.2.10 Detailed lighting design calculations considering the number of fittings as per BOQ shall be submitted by contractor for approval of BHEL / ultimate customer.

1.2.11 The detailed drawings showing lighting layout, disposition and location of lighting fixtures, receptacles, switchboards, ceiling fan points etc, wiring scheme, wiring & conduit layout, fixing details, OGAs of all equipment, Cable schedule for switchyard etc shall be submitted for approval.

- 1.2.12 All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded in compliance with the provision of Customer Specification/I.E. rules.

1.3 LIGHTING SYSTEM DESCRIPTION:

Indoor lighting distribution panel, LP-1 - 415 V A.C. Indoor type Lighting Panel with 415 V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch as incomer, 18 nos. 20A, 240 V, 1 pole MCBs as outgoing feeders.

Indoor lighting distribution panel, LP-2 - 415 V A.C. Indoor Lighting panel with 415 V, 3ph, 4W bus & one 63A TP & N Switch as incomer and 12 nos 20A , 240V 1 pole MCBs as outgoing feeder.

Indoor DC emergency lighting panel , DCELP- Indoor type emergency lighting panel with 240V bus, one no 20A switch fuse as incomer and 6 nos 16A two pole MCB with back up fuse as outgoing feeders.

Outdoor lighting panel , SLP - 415 V A.C. Outdoor type Panel with 415 V, 100A, 3 ph, 4 Wire bus, one 63A TP & N switch as incomer, 18 nos. 20A, 240V, 1 pole MCBs as outgoing feeders.

The lighting panel shall be provided with 63A contactor, frequency compensated timer switch, photo-cell switch push- buttons for automatic control of street/area lighting with provision for manual override.

Split AC distribution panel - 415 V indoor panel , **63A, 20kA for 1s**, 3 phase, 4 wire bus and one 63A, TPN, MCB with earth leakage protection (30mA) as incomer, 8 nos. outgoing 32A DP MCB.

Ventilation fans distribution panel - 415 V indoor panel, **63A, 20kA for 1s**, 3 phase, 4 wire bus and one 63A, TPN, MCB with earth leakage protection (30mA) incomer, 8 nos. outgoing 32A TPN MCB

It may be noted that suitable nos. of 1200 mm sweep ceiling fans with stepped electronic regulator and flush mounted on switchboard shall be provided in Store.

1.4 SCOPE OF SUPPLIES & SERVICES:

1.4.1 SCOPE OF SUPPLY MATERIAL & ERECTION MATERIAL

- a) The main items to be furnished for Substation under this contract are detailed in Bill of Quantity (**Annexure-1**) and shall be read in conjunction with other clauses of this specification.
- b) All associated items, though not specifically mentioned but required for safe and satisfactory operation of equipment/ system will also be treated as included and the same shall be supplied at NO EXTRA COST to Purchaser.
- c) Further, in case any type of luminaire/ panels etc not included below but are required meeting the technical specification shall be specifically brought out in the offer/shall be supplied.

- d) 415V MLDB (Main lighting distribution board), ELDB (emergency lighting distribution board) are being supplied and erected by BHEL.
- e) Lighting Junction box (JB) – The contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts, screws etc required for erection are also included in scope of the contractor.
- f) Bidder shall indicate in his offer, catalogue nos. of all equipment offered.
- g) The continuous conductor of 16 SWG GI wire shall be run all along each conduit run. The conductor shall be connected to each panel ground bus. All junction boxes, receptacles, switches, lighting fixtures etc. shall be connected to 16 SWG ground wire. Supply of 16 SWG ground wire is in contractor's scope.
- h) Supply of all other items such as wires, steel wire, lugs, cable glands, earthing material etc required to complete works are in bidder's scope.
- i) Buried cable trench can be used in outdoor area. Contractor shall construct the cable trenches required for directly buried cables. The scope of work shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and ramming, supply and installation of route markers and joint markers.

1.4.2 FREE ISSUE ITEMS FROM PURCHASER:

The following shall be free issue items from BHEL:

- Multicore power cables as listed in BOQ
- 75x12 mm GI flat for earthing
- 50x6 mm GI flat for earthing
- 110/50 mm GI / PVC pipe
- 40 mm dia MS rod for earthing

The sizes of cables indicated are tentative. Actual size required shall be decided at detailed engineering stage. ETC rate quoted shall remain same even if size changes.

Erection, testing and commissioning of these cables, MS Rod & earth strip will be in bidder's scope. Supply of all other items such as cables, wires, steel wire, lugs, Cable glands, earthing material etc required to complete the works are in bidder's scope.

1.4.3 SCOPE OF SERVICES:

The bidder shall quote for ETC which include civil works of lighting panels, cable termination & earthing against each item as applicable.

1.4.3.1 ERECTION COMMISSIONING AND TESTING:

- a) The Contractor shall give the offer for Erection, Testing and Commissioning of the Illumination Equipment at Site.

- b) The scope of ETC shall include receipt of material at site, unloading at site, storage, handling of equipment/ material at site, erection of equipment / material at site including fabrication, equipment and system testing, commissioning of the entire system. **Store for Illumination material shall be provided by BHEL.**
- c) Conducting lux level measurement as per approved designs to the satisfaction of owner / purchaser.
- d) All material and consumables required for erection work shall be in Contractor's scope. Erection material shall cover, but not limited to, Clamps etc for Luminaries (both indoor and outdoor) , Connections between Junction Boxes and Luminaries in outdoor area, All cable glands, lugs and ferrules require for cabling/ wiring. Any other material required for erection shall deemed to be in Contractor's scope. Holes shall not be drilled on the galvanized substation gantry & LM structures.
- e) Earthing of all electrical equipment as per requirements.
- f) Contractor shall arrange all machinery tools & tackles, instruments and Consumables required for erection, commissioning and testing of the system.
- g) Contractor shall ensure that sufficient quantity of commissioning spares is made available for timely completion of commissioning of the system. The contractor shall furnish a list of Commissioning spares that will be brought by him. The unused commissioning spares shall be returnable to the Bidder.
- h) Laying & termination of power and control cable from outdoor Lighting panel to JB & from JB to fixtures shall be under scope of this specification.
- i) Laying & termination of power and control cable from split AC power distribution to split AC & ventilation fans distribution panel to ventilation fans shall be in supplier's scope.
- j) Where cables are to be laid in GI pipe / PVC pipe, excavation, filling etc. deemed to be included in erection cost quoted.

1.4.3.2 Civil Works:

- a. Civil works such as foundation for Street Lighting Poles, 30m Lighting Mast and outdoor Lighting Panels etc. shall be done by the bidder. The rates for these civil works shall be deemed included in the erection rates of respective items.
- b. Wherever cable is laid in buried trench, the excavation and filling shall be done by bidder free of cost.
- c. All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grounding of anchor bolts, sills, inserts and fastening devices shall be carried out by the contractor including minor modification of civil works as may be required for erection.
- d. Any cutting of masonry / concrete work, which is necessary shall be done by the contractor at his own cost and shall be made good to match the original work.

- e. Wall openings at suitable locations for ventilation fans shall be made by the contractor. Civil works such as grouting, filling up of crevices/ cut outs etc during installation of equipment shall also be in contractor's scope. Any other damage caused to civil works during ETC work of the equipment/ system shall be made good to the original finish by the Contractor at no extra cost to the Purchaser.

1.4.3.3 EARTHING: of all electrical equipment as per requirement

1.4.3.4 Scope of work for Air Conditioning & Ventilation System and Fire-fighting in Control room (to be done by Illumination contractor)

Supply and erection of Split AC, exhaust fans for battery rooms & Ventilation fans shall be in BHEL scope. However panels for power distribution and wiring/cabling for the same is in illumination supplier scope.

Bidder shall supply and lay conduits in Control Room Building, GIS building for fire detection panels, Air conditioning & Ventilation system.

It shall be bidders' responsibility to supply and provide wiring, single phase supply points for Split AC units, and 3 phase supply points for ventilation fans. Typical power supply distribution has been shown in Single Line Diagram for LT AC & DC System (Refer Annexure-3). Tentative no. of 2 TR AC units in Control room and provisional AC Power supply point requirement are as follows:

Name of area	Details of power supply required
Office Room	5 nos. 230 V/ 1-ph supply points with DPMCB (32A)
Conference room	3 nos. 230 V/ 1-ph supply points with DPMCB (32A)
Electrical Lab	4 nos. 230 V/ 1-ph supply points with DPMCB (32A)

There shall be single supply point required for each 2 TR split AC inside control building. Power supply points to split AC units through DPMCB (32A) shall be provided in individual rooms as per the above distribution.

Further, for Ventilation fans, it shall be the responsibility of bidder to provide power supply points in each of the rooms to feed small exhaust fans in these rooms. Ampere rating of power supply points to ventilation fans to be ensured is listed as below:

Name of Area	Details of power supply required
Cable cellar	3 nos. 415 V/ 3-ph supply points with TPMCB (32A)
ACDC Room	4 nos. 415 V/ 3-ph supply points with TPMCB (32A)
Battery room	3 nos. 415 V/ 3-ph supply points with TPMCB (32A)

1.5 TYPE TESTS:

Bidder shall submit valid type test reports of the tests as per relevant IS/IEC carried out within last five years from the date of LOI for BHEL i.e. 05.09.2014.

These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. These test reports shall be vetted by GSECL/DCPL/BHEL at contract stage. If any test report(s) is not acceptable by customer during contract execution stage, same has to be conducted by bidder without any commercial and delivery implication.

All acceptance and routine tests as per relevant standards and specification shall be deemed to be included in the bid price.

All equipment/cables shall be of proven design and type tested as per relevant standard. Type test certificates/specific type tests shall furnished/conducted, if asked for with reference to any specific equipment in the respective sub-section of the Specification.

1.6 INSPECTION & TESTING:

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on equipment in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and ONGC in accordance with agreed quality plan with 3 weeks advance information.

1.7 QUALITY PLAN:

The contractor shall carry out the works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

Attached Manufacturing Quality Assurance Plan (MQP) format in Section-3 shall be followed.

1.8 HANDING & TAKING OVER

It is the responsibility of the Contractor to run and maintain the system supplied by them for a period of 3 months and subsequently hand over the same to BHEL/owner. Contractor shall assist BHEL to hand over the system supplied by them to owner.

1.8 UTILITIES AVAILABLE:

Construction water and 415V power shall be available at one point at each substation. Bidder shall be required to make own arrangement for taking supplies from there.

ANNEXURE-A

It is confirmed that there are no deviations and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and/ or exceptions. Further it is confirmed that at all drawings / data sheets/QP/ type tests reports shall be submitted to BHEL for organizing approval of ultimate customer. Also, furnishing of all relevant information / repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL & without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____
Designation _____
Place _____
Date _____

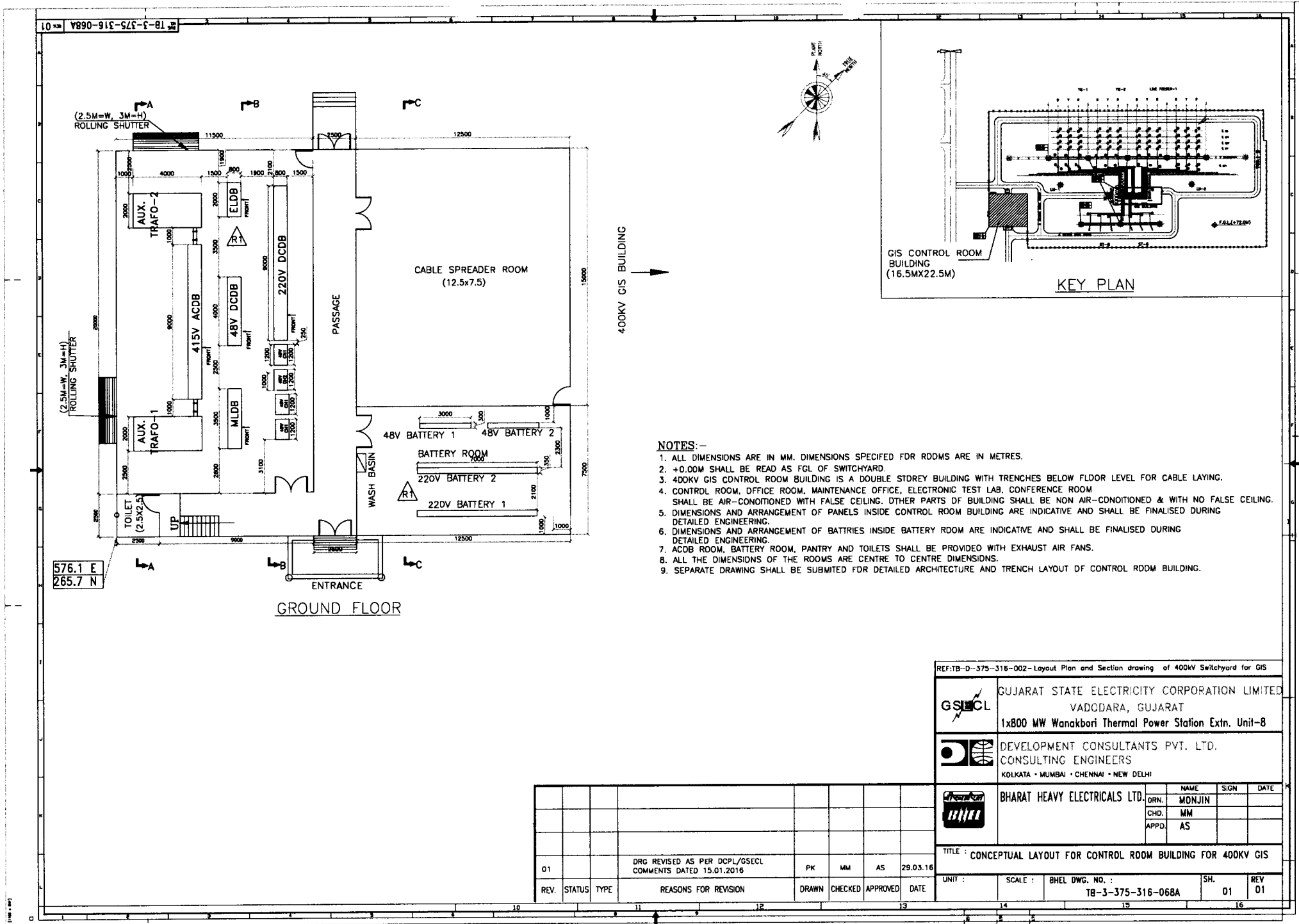
Company seal

SN	Description	Unit	Qty	
			Supply	ETC
1	415V AC Indoor Lighting distribution Panel - LP2 (wall mounted)	Nos.	3	3
2	415V AC Indoor Lighting distribution Panel - LP1 (wall mounted)	Nos.	1	1
3	220V DC Indoor dc Lighting Panels (wall mounted) - DCELP	Nos.	3	3
4	415V AC Indoor split air conditioner distribution Panels (wall mounted)	No.	2	2
5	415 V AC indoor ventilation fans distribution Panels (wall mounted)	No.	2	2
6	lighting fixture type - DA with 2x28 W T5 lamp	Nos.	72	72
7	lighting fixture type - DF with 2x28 W T5 lamp	Nos.	148	148
8	lighting fixture type DL with 2x28W T5 lamp	Nos.	26	26
9	lighting fixture type HB - 250/400W, high bay luminaire	Nos.	11	11
10	lighting fixture type- A(1), 1x100 W GSI, 240 V AC 220 V DC	Nos.	26	26
11	lighting fixture type- DC, 1x100 W Comptalux, 240 V AC 220 V DC	Nos.	14	14
12	Marine type lamp , 100W	nos.	1	1
13	Battery operated Portable lighting Fixture, type M3	Nos.	2	0
14	Entry/Exit sign board - fixture type EL, 1x20W,	Nos.	4	4
15	16A, 240V, Indoor Receptacle Single Phase, 3-pin type, type- RB	Nos.	4	4
16	32A, 240V, Indoor Receptacle Single Phase with DP MCB for split AC	Nos.	12	12
17	32A, 415V, Indoor industrial Receptacle three Phase alongwith TPN MCB for ventilation fans	Nos.	10	10
18	20A, 415V, Indoor Industrial Receptacle three Phase	Nos.	2	2
19	Modular switchboard, Type-S2	Nos.	25	25
20	Modular switchboard, type -S3	Nos.	4	4
21	Ceiling fan type FA	Nos.	10	10
22	Ceiling fan type FB	Nos.	1	1
23	Point wiring from Lighting panel to switchboard	Nos.	29	29
24	Point wiring from switchboard to AC lighting fixtures/exit sign board /fan	Nos.	257	257
25	Point wiring from Lighting panel to DC lighting fixtures	Nos.	40	40
26	Point wiring from Lighting panel to receptacles	Nos.	26	26
27	OUTDOOR SWITCHYARD LIGHTING : lighting fixture type- NY, 1x150W HPSV, street lighting luminaire	Nos.	32	32
28	OUTDOOR SWITCHYARD LIGHTING: Outdoor Lighting Panel for Switchyard Lighting -SLP	Nos.	4	4
29	OUTDOOR SWITCHYARD LIGHTING:- Flood light type Lighting Fixture 1x400W or equivalent.	Nos.	4	4
30	OUTDOOR SWITCHYARD LIGHTING:-Flood light type Lighting Fixture 2x400W or equivalent.	Nos.	61	61
31	OUTDOOR SWITCHYARD LIGHTING:- Steel tubular pole, type TA (single arm), alongwith JB	Nos.	25	25
32	OUTDOOR SWITCHYARD LIGHTING:- Outdoor junction box	Nos.	4	4
33	OUTDOOR SWITCHYARD LIGHTING:- 63A, 415V, 3 phase outdoor industrial Receptacle for welding	Nos.	3	3
34	OUTDOOR SWITCHYARD LIGHTING:- Ladder type- M1	nos.	1	0
35	OUTDOOR SWITCHYARD LIGHTING:- Ladder type- M2	nos.	1	0
36	OUTDOOR SWITCHYARD LIGHTING:- 30m high LM Mast with Lantern Carriage (Double Drum Winch type) for Switchyard Lighting	nos.	1	1
37	COMMON ITEMS:-Cable Laying - Cabling including laying, tagging , dressing, ferruling, lugging, installation of cable gland ,soldering, tapping, jointing, crimping, termination, and drilling/ cutting holes in cable gland plates- laying can be either on trays, supports, underground, buried in ground or through GI/PVC pipe over/under ground, through wall etc. All erection materials viz. ferrules, copper lugs, cable ties / straps, Al. tags, markers, GI / PVC wall sleeves with rubber / nylon bushes and flexible steel conduits shall be supplied by bidder.2C x 2.5 Sq. mm Cu/PVC cables	m		4000
38	COMMON ITEMS:- 75X12 mm GI Flat	m		100
39	COMMON ITEMS:- 50X 6 mm GI Flat	m		100
40	COMMON ITEMS:- 110/55mm PVC/GI pipe	m		100
41	COMMON ITEMS:- 40 MM dia MS rod	m		100

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SN	Description	Unit	Qty
42	MANDATORY SPARES:- High Pressure Sodium Vapour Lamp 150W	Nos.	5
43	MANDATORY SPARES:-High Pressure Sodium Vapour Lamp 250W	Nos.	5
44	MANDATORY SPARES:-High Pressure Sodium Vapour Lamp 400W	Nos.	5
45	MANDATORY SPARES:- Ignitors (Separate type) for High Pressure Sodium Vapour Lamp	Nos.	20
46	MANDATORY SPARES:-Ballast for 1 x 150 W High Pressure Sodium Vapour Lamp	Nos.	10
47	MANDATORY SPARES:-Ballast for 1 x 250 W High Pressure Sodium Vapour Lamp	Nos.	5
48	MANDATORY SPARES:-Capacitor for 1 x 150 W High Pressure Sodium Vapour Lamp	Nos.	5
49	MANDATORY SPARES:-Capacitor for 1 x 250 W High Pressure Sodium Vapour Lamp	Nos.	5
50	MANDATORY SPARES:-Capacitor for 1 x 400 W High Pressure Sodium Vapour Lamp	Nos.	5
51	MANDATORY SPARES:-Fluorescent Lamp 2 X 28W (T5)	Nos.	5
52	MANDATORY SPARES:-Ballast for Fluorescent Lamp 2 X 28W (T5)	Nos.	5
53	MANDATORY SPARES:-Clockswitch type Time Switch	Lot	1
54	Miniature Circuit Breakers (M.C. Bs) :- 1-Pole 20 Amps.	Nos.	4
55	Miniature Circuit Breakers (M.C. Bs) :- 2-Pole 20 Amps.	Nos.	4
56	Miniature Circuit Breakers (M.C. Bs) :- 2-Pole 16 Amps.	Nos.	4
57	Receptacles 5 Amp	Nos.	4
58	Receptacles 15 Amp	Nos.	4
59	Receptacles 63 Amp	Nos.	1
Remark 1 -Price for supply of all applicable illumination erection hardware material shall be included along with above BOQ in offer. List of erection hardware material for illumination works are mentioned below.			
A	For Indoor works: 3 way, G.I., circular J.B. (20mm and 25mm), 4 way, G.I., circular J.B. (20mm and 25mm), 90deg, G.I., Inspection Bend (20mm and 25mm), 90deg, G.I., Normal Bend (20mm and 25mm), Heavy duty, Saddle with base (20mm and 25mm), Heavy duty, Saddle without base (20mm and 25mm), M4X25mm, steel screw with nut and washer, G.I. check nut/lock nut (20mm and 25mm), PVC Rawl plug, 6mm, Wooden screw, 35mm, Earth clip/clamp (20mm and 25mm), Cleat fabrication out of 25x6mm M.S. flat (for hanging conduit in false ceiling areas, Anchor fastner (M10x75mm for cleats, M12x75mm for lighting panels), Rubber bush (20mm and 25mm), 20mm, PVC, flexible conduit, 20mm, PVC, Coupling, Swing out bracket, 20mm, Heavy duty, ball socket, Machine screw (for fixing surface mounting fixtures on circular J.B.), PVC closure (20mm and 25mm), Reducer (20mm and 25mm). GI conduits, epoxy coated conduits for corrosive areas, 1.5, 2.5, 4, 6 & 10 sq. mm wires, GI wire for earthing.		
B	For Outdoor works: 20x1.5mm Aluminium flat, M12x40mm, G.I. Bolt with nut and washer for fixing outdoor lighting panels, M6x30mm, G.I. Bolt with nut and washer for fixing control gear boxes, M8x30mm, G.I. Bolt with nut and washer for fixing outdoor J.B.s, SLP, M10x35mm, G.I. Bolt with nut and washer for fixing outdoor lighting fixtures, G.I., Earth wire from J.B. to lighting fixtures, Mounting brackets for lighting fixtures for 1x400W fixtures/2x400W fixtures, GI wire for earthing.		
Remark 2 : The above quantities (BOQ) are as per preliminary design only. The detail design will be submitted by Vendor and subject to approval by Customer. The BOQ quantities which are finalised after approval has to be supplied. BHEL reserves the right for quantity variation due to any reason upto + 25% of total value at same unit rate and terms during execution of contract. The quantity of individual items may however vary upto any extent			
Remark 3 : If extra items required for completion of Job but not covered above, shall be quoted separately as a list of items and same shall be submitted with the bid (price of supply and ETC to be quoted on Lumpsum basis).			

Mumt



400KV GIS BUILDING

NOTES:-

1. ALL DIMENSIONS ARE IN MM. DIMENSIONS SPECIFIED FOR ROOMS ARE IN METRES.
2. +0.00M SHALL BE READ AS FGL OF SWITCHYARD
3. 400KV GIS CONTROL ROOM BUILDING IS A DOUBLE STOREY BUILDING WITH TRENCHES BELOW FLOOR LEVEL FOR CABLE LAYING.
4. CONTROL ROOM, OFFICE ROOM, MAINTENANCE OFFICE, ELECTRONIC TEST LAB, CONFERENCE ROOM SHALL BE AIR-CONDITIONED WITH FALSE CEILING. OTHER PARTS OF BUILDING SHALL BE NON AIR-CONDTIONED & WITH NO FALSE CEILING.
5. DIMENSIONS AND ARRANGEMENT OF PANELS INSIDE CONTROL ROOM BUILDING ARE INDICATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.
6. DIMENSIONS AND ARRANGEMENT OF BATTERIES INSIDE BATTERY ROOM ARE INDICATIVE AND SHALL BE FINALISED DURING DETAILED ENGINEERING.
7. ACDB ROOM, BATTERY ROOM, PANTRY AND TOILETS SHALL BE PROVIDED WITH EXHAUST AIR FANS.
8. ALL THE DIMENSIONS OF THE ROOMS ARE CENTRE TO CENTRE DIMENSIONS.
9. SEPARATE DRAWING SHALL BE SUBMITTED FOR DETAILED ARCHITECTURE AND TRENCH LAYOUT OF CONTROL ROOM BUILDING.

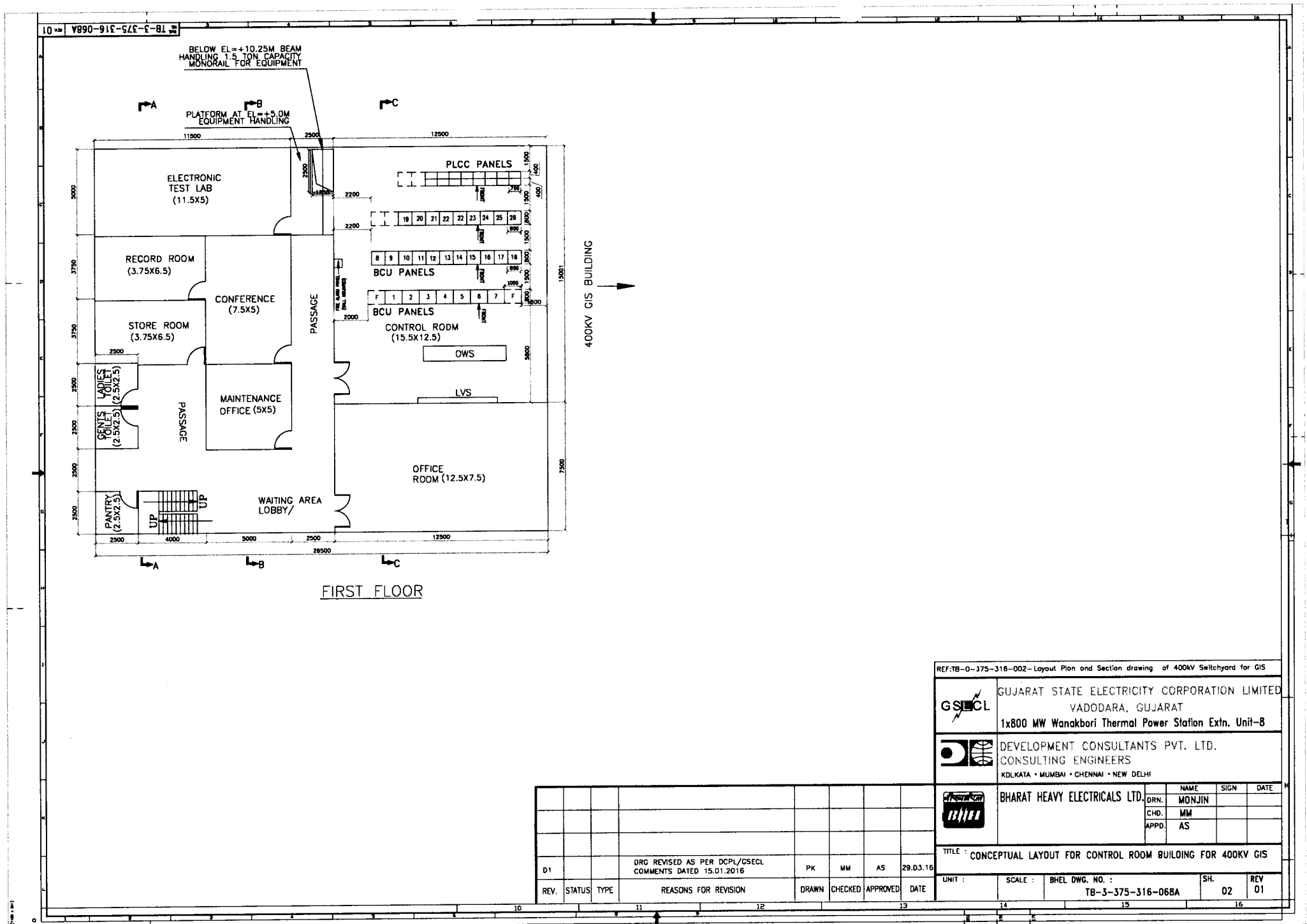
REF:TB-D-375-316-002-Layout Plan and Section drawing of 400KV Switchyard for GIS

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	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI			
	BHARAT HEAVY ELECTRICALS LTD.			
	ORIN.	NAME	SIGN	DATE
	CHD.	MM		
	APPD.	AS		

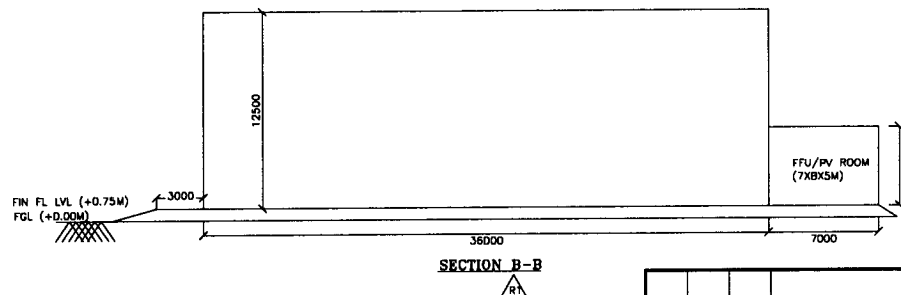
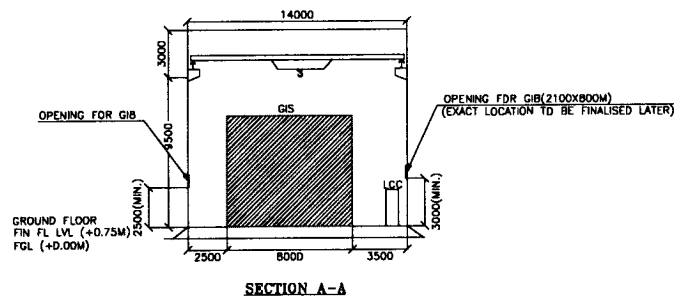
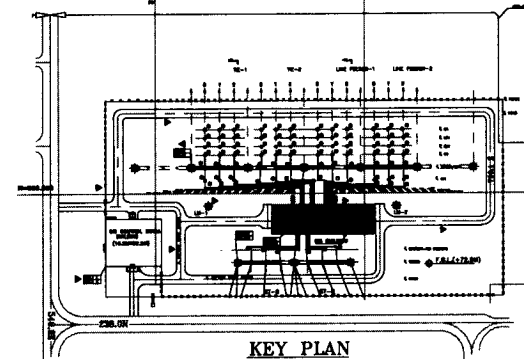
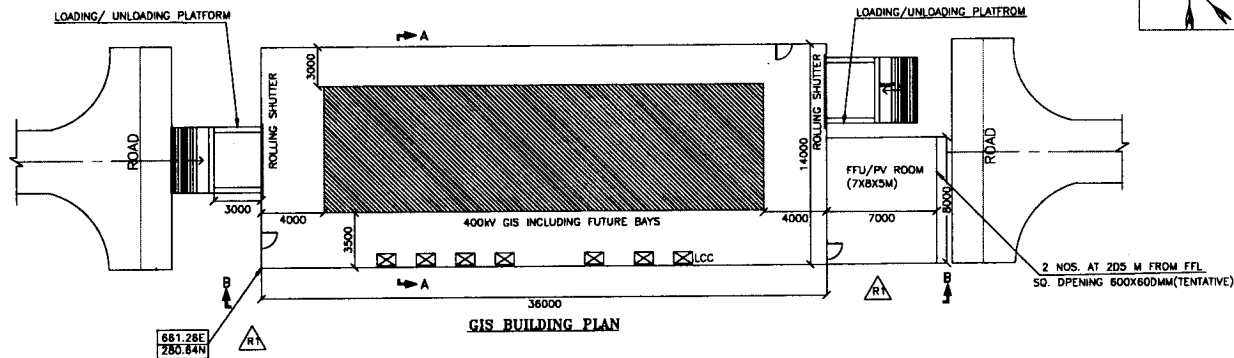
01			DRG REVISED AS PER DCPL/GSECL COMMENTS DATED 15.01.2016	PK	MM	AS	29.03.16
REV.	STATUS	TYPE	REASONS FOR REVISION	DRAWN	CHECKED	APPROVED	DATE

TITLE : CONCEPTUAL LAYOUT FOR CONTROL ROOM BUILDING FOR 400KV GIS				
UNIT :	SCALE :	BHEL DWG. NO. : TB-3-375-316-068A	SH. 01	REV 01

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18-3-375-316-068A 01



- NOTE:-
1. ALL DIMENSIONS ARE IN MM AND MINIMUM CLEAR DIMENSIONS.
 2. GIS ROOM SHALL BE PROVIDED WITH DUCTED VENTILATION.
 3. FINAL LOCATION OF CABLE TRENCH ENTRY SHALL BE AS PER APPROVED TRENCH LAYOUT.
 4. DOOR SHALL BE 2500(H)X1500(W) IN SIZE.
 5. ROLLING SHUTTER FOR SHALL BE 5000(H)X4500(W) IN SIZE.
 6. TENTATIVE CAPACITY OF EOT CRANE = 6T.
 7. GIS DIMENSIONS ARE TENTATIVE.

REFERENCE:-
1. LAYOUT PLAN AND SECTION : TB-0-375-316-002

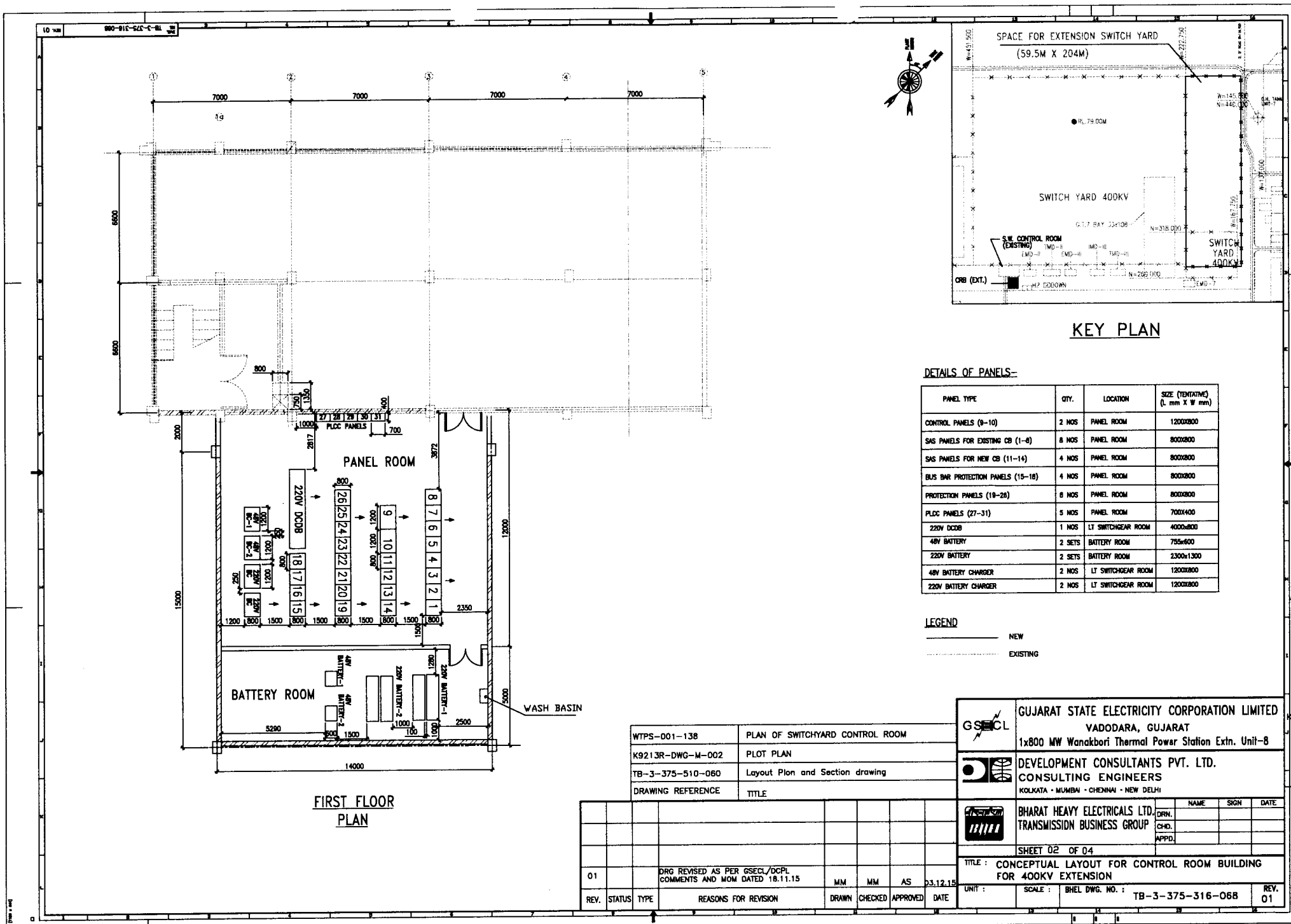
GSECL	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT			
	1x800 MW Wanakbori Thermal Power Station Extn. Unit-B			
Development Consultants Pvt. Ltd.	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS			
	KOLKATA • MUMBAI • CHENNAI • NEW DELHI			
Bharat Heavy Electricals Ltd.	BHARAT HEAVY ELECTRICALS LTD.			
	DRN.	NAME	SIGN	DATE
	CHD.	MM		
	APPD.	MM		
		AS		

TITLE : CONCEPTUAL LAYOUT FOR 400KV GIS BUILDING

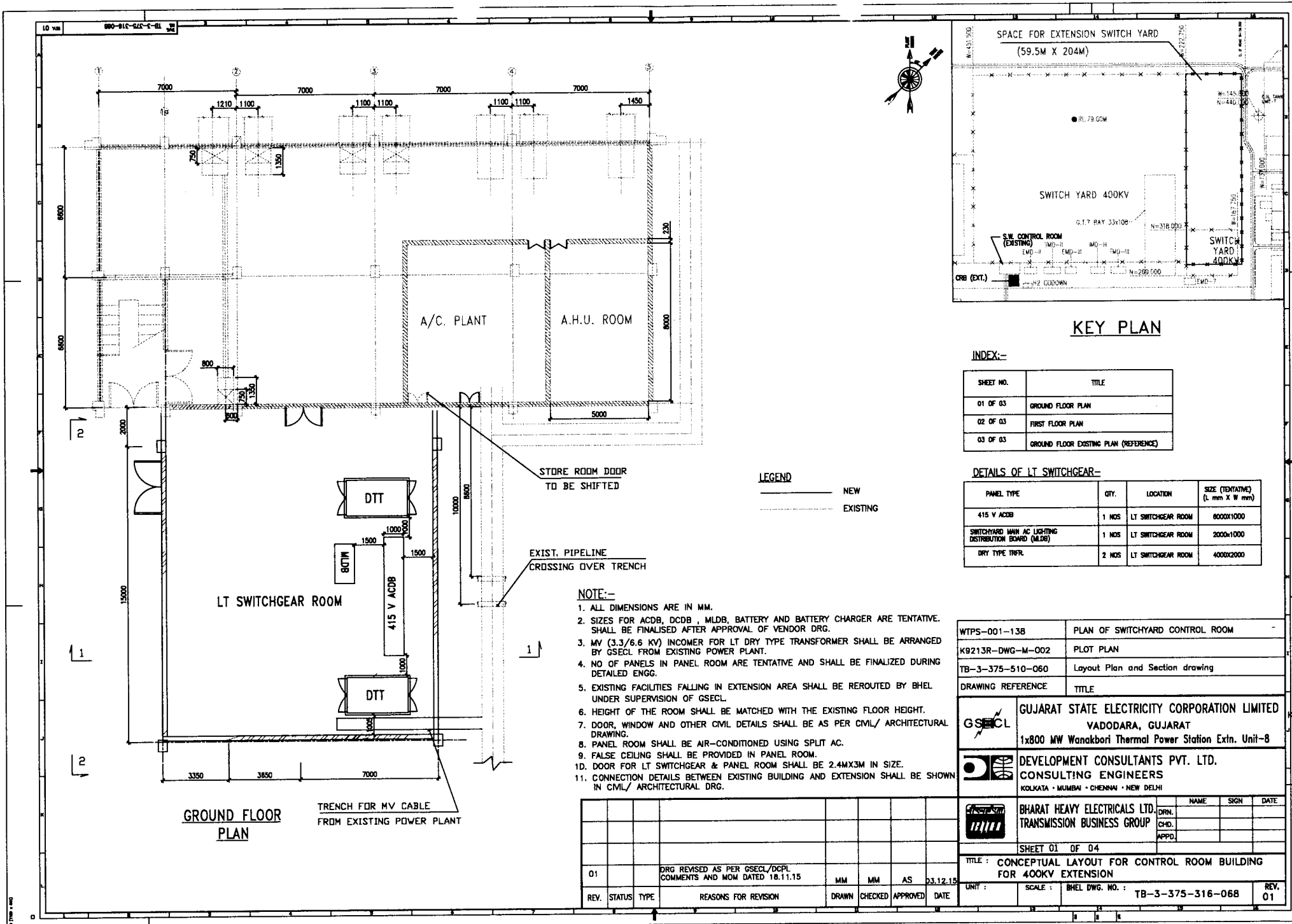
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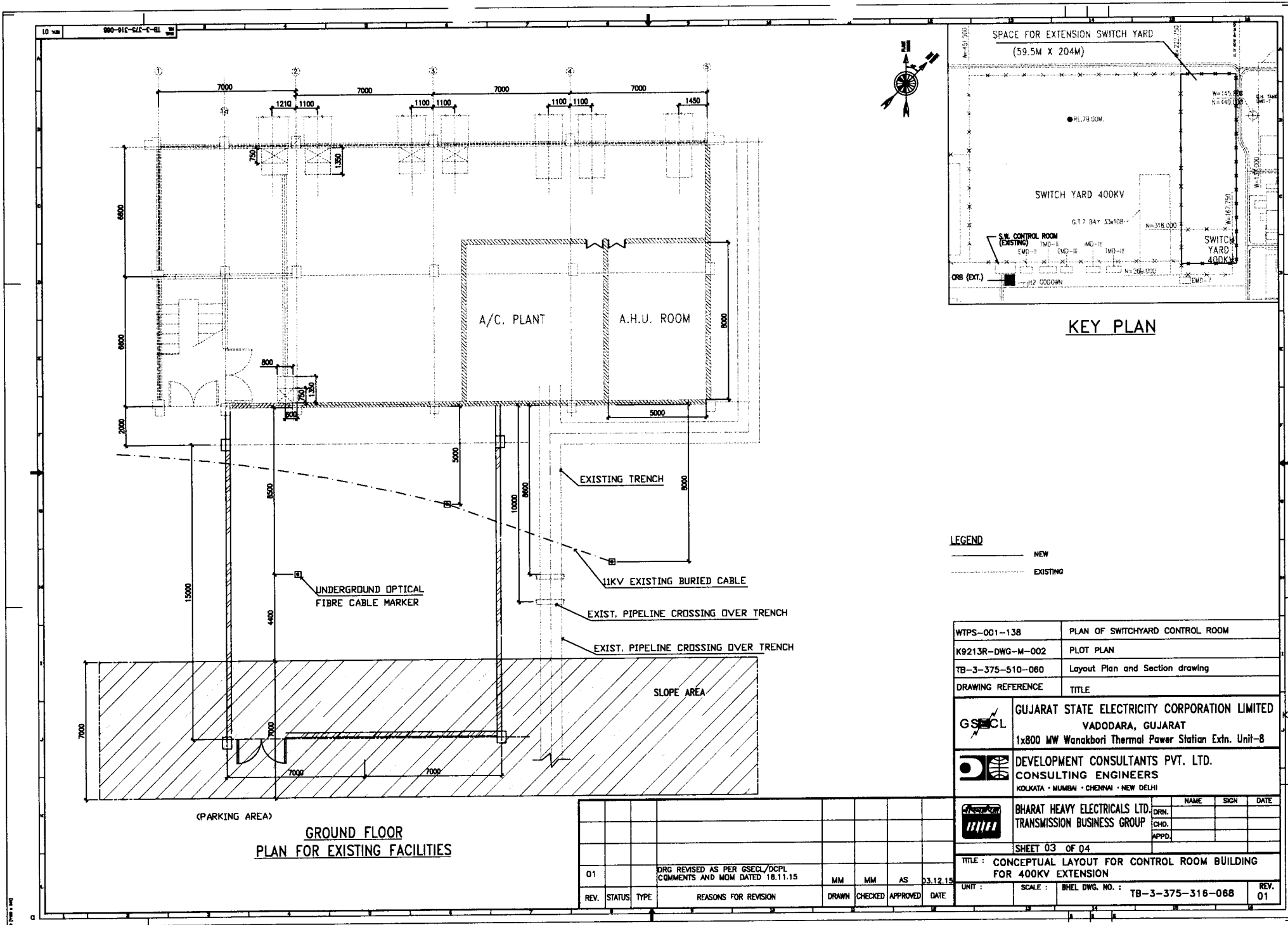
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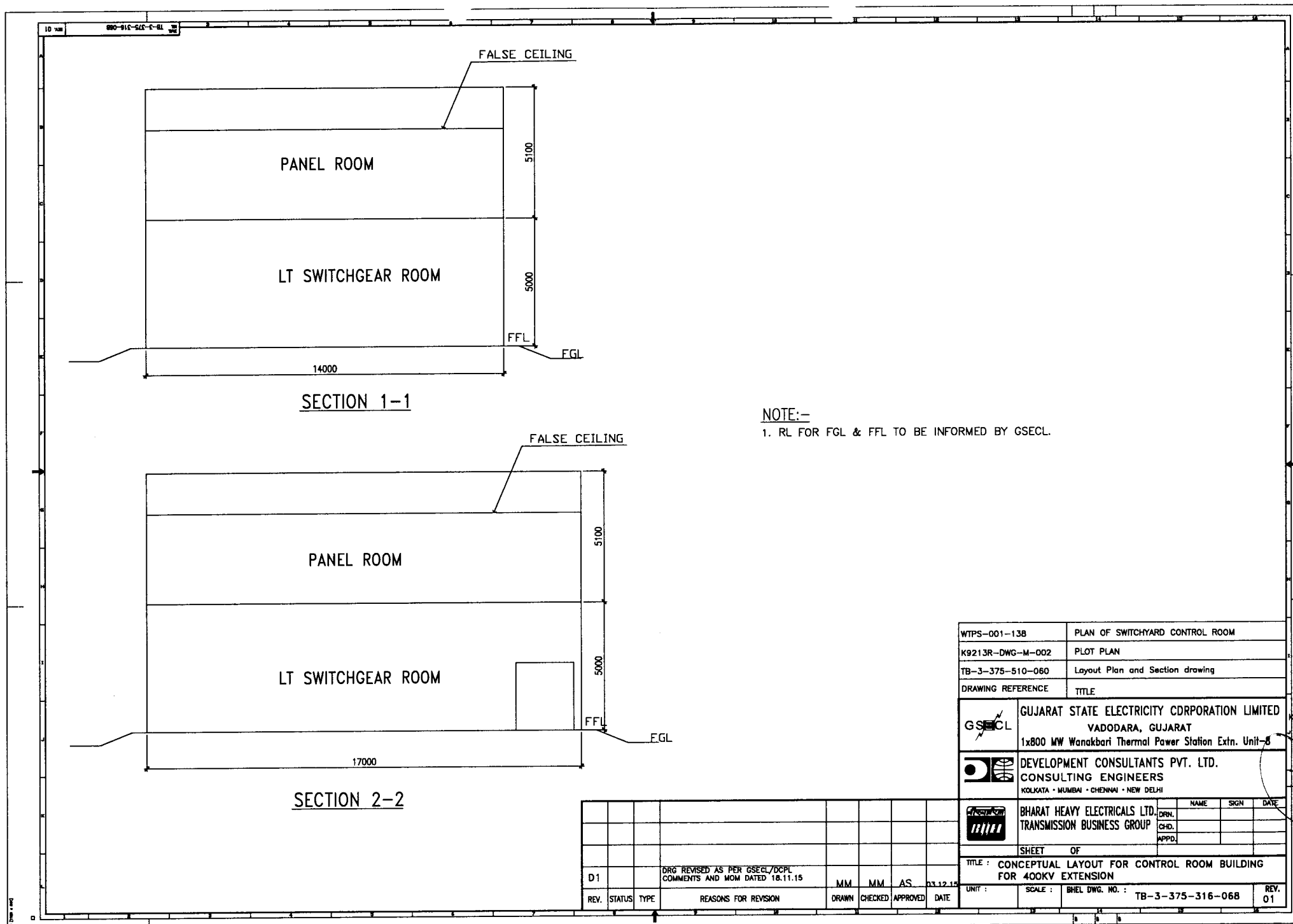
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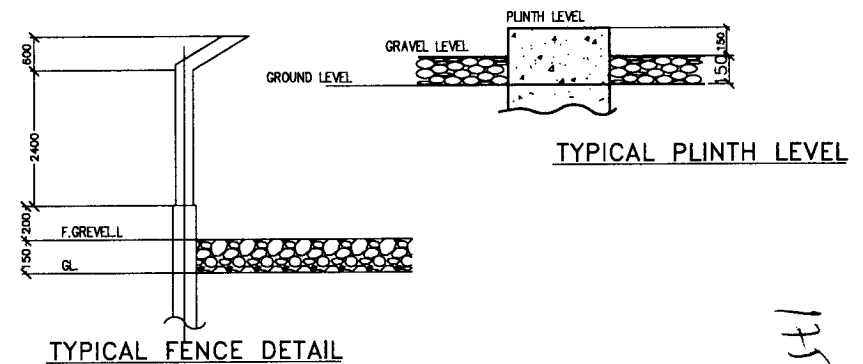
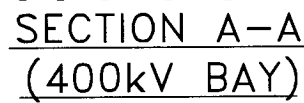


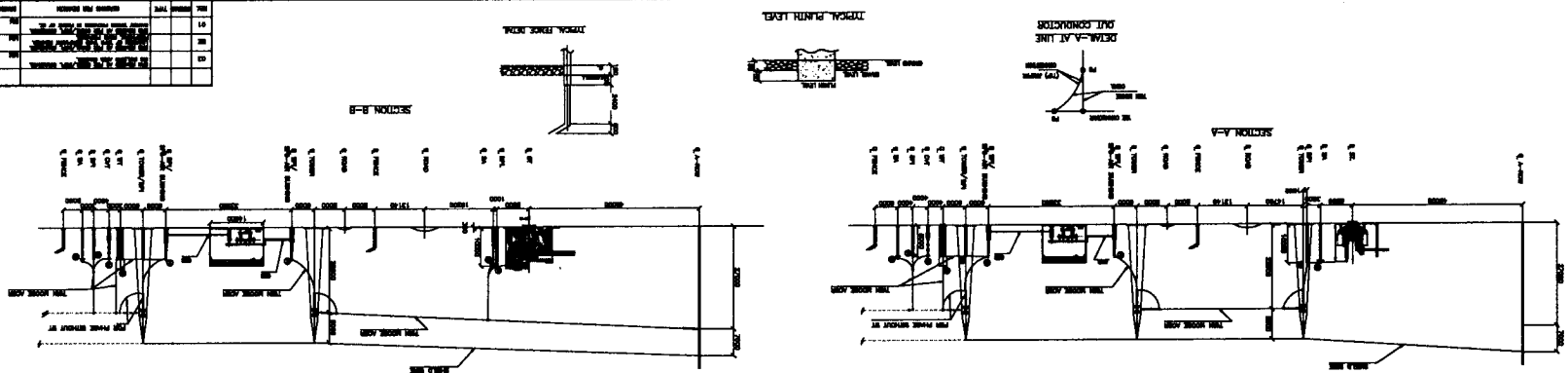
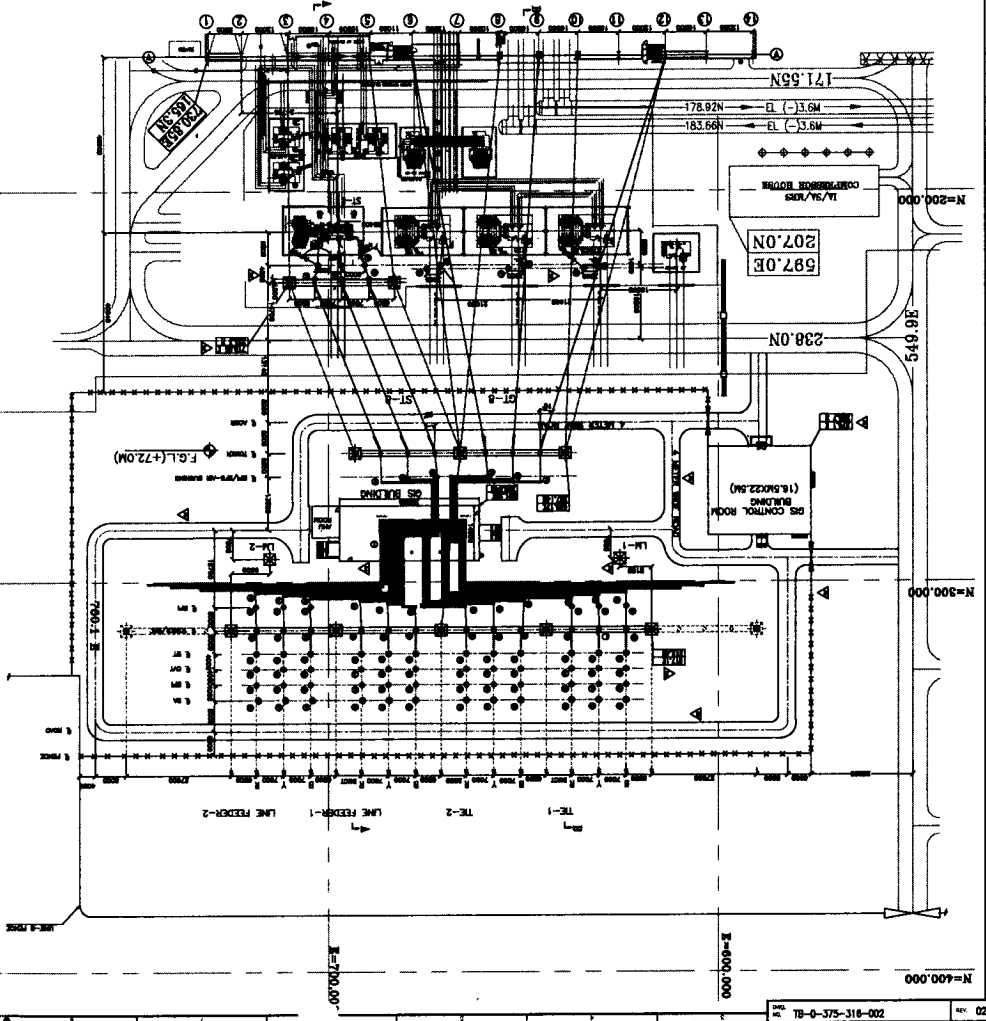
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NOTES:-

1. ALL DIMENSIONS ARE IN METERS.
2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
3. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
4. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
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11. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.

MINIMUM CLEARANCE TABLE

TYPE OF EQUIPMENT	MINIMUM CLEARANCE (mm)
1. BUSBARS	1000
2. SWITCHGEAR	1000
3. TRANSFORMERS	1000
4. CAPACITORS	1000
5. REACTORS	1000
6. OTHER EQUIPMENT	1000

CONDUCTOR SIZE DETAILS

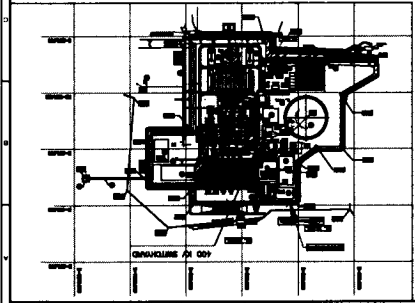
TYPE OF CONDUCTOR	SIZE (mm²)
1. BUSBARS	1000
2. SWITCHGEAR	1000
3. TRANSFORMERS	1000
4. CAPACITORS	1000
5. REACTORS	1000
6. OTHER EQUIPMENT	1000

LIST OF QUANTITY

S.NO.	DESCRIPTION	QUANTITY (MTR.)
1	1. ALL DIMENSIONS ARE IN METERS.	1000
2	2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.	1000
3	3. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
4	4. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
5	5. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
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7	7. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
8	8. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
9	9. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
10	10. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000
11	11. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.	1000

LEGEND TABLE

SYMBOL	DESCRIPTION
1	1. ALL DIMENSIONS ARE IN METERS.
2	2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
3	3. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
4	4. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
5	5. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
6	6. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
7	7. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
8	8. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
9	9. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
10	10. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
11	11. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.



REVISIONS

NO.	DATE	DESCRIPTION
1	10/10/2000	1. ALL DIMENSIONS ARE IN METERS.
2	10/10/2000	2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
3	10/10/2000	3. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
4	10/10/2000	4. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
5	10/10/2000	5. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
6	10/10/2000	6. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
7	10/10/2000	7. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
8	10/10/2000	8. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
9	10/10/2000	9. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
10	10/10/2000	10. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
11	10/10/2000	11. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.

NOTES:-

1. ALL DIMENSIONS ARE IN METERS.
2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
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4. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
5. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.
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11. ALL DIMENSIONS ARE TO BE MAINTAINED AS PER SPECIFICATION.

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Gujarat State Electricity Corporation Ltd.

400kV Switchyard Extension and

400 kV Switchyard for GIS for 1x800 MW Supercritical Thermal Power Project

Technical Specification for Illumination system

Bharat Heavy Electricals Ltd.

Doc. No. TB-375-316-006, Rev. No.00

SECTION 2

GENERAL ELECTRICAL SPECIFICATION

As per GSECL Technical Specifications enclosed as below:

TECHNICAL SPECIFICATION FOR 400KV GAS INSULATED SWITCHGEAR
VOLUME: IIF/2 SECTION-VII, K9213R-EPC-SPC-001

ILLUMINATION SYSTEM NOTES AND DETAILS – DWG NO.
K9213-DWG-E-0800

ANNEXURE-E, TECHNICAL SPECIFICATION FOR INSTALLATION,
K9213R-SPC-001_V2/F1, SEC-XV

VOLUME : IIF/2

SECTION-VII

TECHNICAL SPECIFICATION
FOR
ILLUMINATION SYSTEM

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE OF WORK
2.00.00	SCOPE OF SUPPLY
3.00.00	SCOPE OF SERVICE
4.00.00	GENERAL REQUIREMENTS
5.00.00	DESIGN CRITERIA
6.00.00	SPECIFIC REQUIREMENTS - SUPPLY
7.00.00	SPECIFIC REQUIREMENTS - SERVICES
8.00.00	TESTS
9.00.00	DRAWINGS DATA & MANUALS

ATTACHMENTS

ANNEXURE-A	AVAILABLE POWER SUPPLY
ANNEXURE-B	BROAD LIST OF AREAS TO BE ILLUMINATED
ANNEXURE-C	TYPES & BOM OF LIGHTING FIXTURE AND LAMPS
ANNEXURE-D	ILLUMINATION LEVEL
ANNEXURE-E	RATINGS AND REQUIREMENTS OF LIGHTING TRANSFORMER
ANNEXURE-F	FITTINGS AND ACCESSORIES OF LIGHTING TRANSFORMER

SECTION-VII

TECHNICAL SPECIFICATION FOR ILLUMINATION SYSTEM

1.00.00 SCOPE OF WORK

- 1.01.00 This scope of work shall cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport F.O.R. site of STATION LIGHTING SYSTEM, complete with all materials and accessories for efficient and trouble-free operation.
- 1.02.00 The scope of work shall also include complete installation, testing, commissioning and putting into successful commercial operation of the Lighting System of ~~Power House, Mill building, Transformer Yard, GIS building, Extension part of 400kV switchyard, CHP, AHP, Raw water system, fuel oil system Out side water pump house, Ash dyke pump house area,~~ roads, fencing, open yard, boundary wall, Peripheral road inside boundary wall inclusive of the supply of all labour, tools, implements and supplies.
- 1.03.00 The major areas to be illuminated under the scope of this package are listed in Annexure-B. The areas listed are however indicative only for the purpose of guidance to the Contractor and is subject to change during detail engineering after finalization of plant layouts.

2.00.00 SCOPE OF SUPPLY

- 2.01.00 The equipment and materials within the scope of supply shall include but not limited to:
- a) Lighting Transformer.
 - b) Lighting fixtures with lamps and accessories.
 - c) Lighting panels/boards: Main lighting boards, emergency lighting boards, emergency DC lighting panels, lighting panels, street lighting panels etc. All panels shall be provided with energy saving system.
 - d) Street light poles, flood lighting tower/poles/high masts.
 - e) Ceiling fans, receptacles, switches, switchboards, portable emergency lights, portable 24V supply module including handset maintenance equipment etc.
 - f) Separate DB for 1ph, 240 V power supply is required to be indicated suitably for miscellaneous services supplies.
 - g) ~~Separate DB for 24 V power supply is required to be indicated suitable for 24 V lighting supply.~~
 - h) Separate DB with transformers is required to be considered for welding receptacles.

- i) Cables, wires, splicing/termination/connection accessories.
 - j) Conduit and accessories, junction and pull boxes, terminal blocks.
 - k) Grounding materials and connections.
 - l) All fittings, supports, brackets, anchors, clamps and connections.
 - m) Steel for field fabrication of supports and brackets.
- 2.01.01 Data sheets and technical leaflets on each piece of equipments / devices
- 3.00.00 **SCOPE OF SERVICE**
- 3.01.00 Carrying out of detail engineering including detail design calculations, preparation of lighting layouts showing location of fixtures, cable wires and conduit routing, preparation of cable schedule, and other related drawings as detailed in subsequent clauses and also consider the energy saving system.
- 3.01.01 Furnishing of all labour, skilled and unskilled, supervisory personnel, erection tools and tackles, testing equipment, implements, supplies, consumables & hardware, and transport for timely and efficient execution of the contract work.
- 3.01.02 Preparation of AS-BUILT drawings showing field modifications, if any.
- 4.00.00 **GENERAL REQUIREMENTS**
- 4.01.00 Codes and Standards
- Major standards, which shall be followed, are listed below. Other applicable Indian standards even if not covered in the listed standard shall be followed.
- a) IS-1913
 - b) IS-1977
 - c) IS-10322
 - d) IS-8623
 - e) IS-6064
 - f) IS-8828
 - g) IEC-598
 - h) IS-13703
 - i) IS-13947
 - j) IS-1248

- k) IS-2705
- l) IS-4160
- m) IS-2713
- n) IS-800
- o) IS-2026
- p) IS-2099
- q) IS-694
- r) IS-1554
- s) IS-9537
- t) IS-14772
- u) IS-5133

5.00.00 **DESIGN CRITERIA**

5.01.00 **Design Basis**

5.01.01 The system provides lighting and electric power supply for lighting to ~~main plant areas & transformer yard~~, 400KV GIS Building, Extension part of 400kV switchyard, Boiler, ESP area GHP area, raw water pump house & area, ash dyke pump house & area, boundary fencing, roads, Peripheral roads inside boundary wall etc. under the scope of this package. In addition, it also provides lighting to selected areas during plant emergency conditions.

5.01.02 The system will be installed in an adverse industrial environment. Equipment in some areas will be subject to vibration, coal-dust, fly-ash, oil/water vapours as prevalent in a thermal generating plant.

5.01.03 The design shall be such as to provide minimum lighting levels as specified for different areas.

5.01.04 The systems shall be suitable for operation on available power supply having characteristics as given in the annexure.

5.01.05 All fittings of control room / office shall be energy efficient type.

5.02.00 **System Concept**

The lighting system shall comprise following sub-systems:

5.02.01 **Normal A.C. Lighting**

This will be provided by A.C. lighting fixtures distributed throughout the plant area. These lights will be ON as long as the station A.C. supply is available.

A.C. lighting fixtures will be fed from respective area lighting panels, which in turn will be connected to main lighting distribution board. The main lighting distribution boards will be fed through respective 1:1 ratio lighting transformer, which forms a part of the MLDB. Normal A.C. supply thus made available by the MLDB is 415V-3ph-4W-50HZ effectively grounded. Both the MLDB & the lighting panels shall be provided with at least 20% spare outlets.

5.02.02 Emergency A.C. Lighting

- a) On failure of normal A.C. Supply, emergency A.C. lighting will be provided in selected areas of the powerhouse, boiler area, boiler galleries etc for general visibility, safe movements and operation of important auxiliaries.
- b) The emergency MLDBs (EMLDB) are similar to the MLDB except that lighting transformers in this case are fed from station A.C. Emergency bus having D.G. System backup. Thus power for A.C. emergency lighting is 415V-3ph-4W, 50HZ, effectively grounded.

These lights will be kept "ON" from normal power supply source and upon its failure will be fed from DG.

- c) A.C. emergency lighting fixture will account for 20% of the total lighting fixtures provided in the above mentioned area. In main control room 30% emergency lighting shall be provided.

5.02.03 Emergency D.C. Lighting

- a) This will be provided by D.C. lighting fixtures located strategically in critical operating areas and emergency exits. Emergency DC lighting will be catered by DC emergency lighting distribution (DCELDB) boards. These DCELDBs will feed the DC emergency lighting fixtures directly and through a numbers of DC emergency lighting panels (DCELP) located suitably in respective areas.
- b) The DC Emergency Lighting Distribution Boards will be fed from two power sources, namely -
 - i) Main Lighting Distribution Board (MLDB).
 - ii) 220V DC distribution boards (DCDB).
- c) These lights will be ON all the time - normally from station A.C. Supply, but on its failure from station D.C. supply through automatic switching. On failure of AC supply connected to the panel, under voltage relay shall drop out and shall switch ON the incomer DC contractor and thus the DC supply to lighting Circuit.
- d) Emergency DC Lighting to be considered for CHP shall be as follows :

Min 18 Nos. in main CHP Substation and 6 Nos. in other Substation Building/PMCC Room

~~Min 4 NOs. in each of the Wagon Tippler Control room~~

~~Min 2 Nos. in each floor of TPs, Crusher House, Pump House & any other areas~~

~~Conveyor Gallery/Tunnel at the rate of 30 M interval~~

Emergency lighting shall also be provided at entry, exit and stair cases of Electrical Sub-Station, Control Rooms, TPs, Crusher House and other buildings.

~~Min 10 Nos. in Each Wagon Tippler Area~~

Note: - ~~For CHP area, emergency DC lighting shall be fed from DGDB.~~ Emergency DC light shall switch on automatically in the event of failure of AC power supply.

5.02.04 24V, 1 ph AC maintenance lighting system

Separate DB for 24V power supply shall be provided for 24V maintenance lighting.

5.02.05 Street/Area Lighting

Time switch and photocell will be used for controlling area lights with provision for manual override and also have the provision of latest Energy Saving Systems.

~~Same arrangement will also be used for controlling, boiler gallery, ESP area, turbine floor (high bay) area illumination.~~

5.02.06 Remote Emergency Lighting

This will be provided in isolated building /area/mobile equipment viz. stacker-Reclaimer where D.C. supply is not available by self-contained battery / automatic charger/inverter/flood light units. These portable emergency light units will be energized automatically on loss of normal A.C. supply.

5.03.00 **Ratings & Requirements**

5.03.01 All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.

5.03.02 Switch, fuses, MCCB, miniature circuit breakers (MCB), busbar shall be fully rated for short circuit level at the point of application. MCB shall have back-up HRC fuse if its rating is less than the available short circuit current.

5.03.03 All equipment and accessories shall have proper enclosure to suit the site conditions. Hazardous areas shall have flame-proof enclosure.

5.03.04 All wiring from lighting panels to fixtures and receptacles shall be carried out by PVC wires in G.I. Conduits.

5.03.05 Heavy duty XLPE FRLS cables as per cable specification will be used for connections :

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- a) From main lighting board to area lighting panels
- b) From street/area lighting panel to street light poles.
- From 415V MCCs to receptacles of 63A and above
- 5.03.06 The lighting system will be supplied from 415V/415V $\pm$ 5%, indoor, dry type lighting transformers. However it shall be so chosen to limit the fault level within 9kA.
- 5.03.07 Suitable number of Flood Lighting Towers / Lighting Masts with adequate HPSV Flood Light will be provided for necessary outdoor areas as required.
- 5.03.08 Lighting of all main streets, approach roads to various buildings shall be included.
- 5.03.09 Each lighting panel shall be provided with adequate number of outgoing miniature circuit breaker for controlling fixtures. 5A, 3Pin sockets shall be fed from the lighting panel through separate circuits.
- 5.03.10 All A.C. Normal and Emergency A.C. lighting shall be provided with Energy Saving System.
- 5.04.00 **Method of Calculation**
- 5.04.01 Standard Lumen method shall be adopted for interior & exterior lighting in order to determine the number of lighting fixtures for obtaining the desired average level of illumination.
- 5.04.02 The coefficient of utilization shall be considered to take care of Lumen loss due to :
- a) effect of room dimensions.
- b) absorption of light in luminaires.
- c) absorption of light at various room surfaces i.e ceiling wall etc.
- d) floor cavity, ceiling cavity.
- e) mounting height.
- 5.04.03 Moreover a maintenance factor shall also be considered to account for the fall of illumination due to aging, pollution like dust deposit etc. Maintenance factors to be considered for various areas shall be as follows :

Area	Maintenance factor
Control Room	0.75
Switchgear/MCC Room	0.65
General indoor area	0.60

Dusty Area 0.55

Utilization factor

- i) Dusty area such as conveyor galleries / Tunnels, TPS / Crusher House etc. = 50 % ceiling, 30% wall, 10 % floor.
- ii) Clear areas such as switchgear room/control room etc. =70 % ceiling, 50 % wall, 10 % floor.
- iii) Working plan = a) At conveyor walkway level. b) At Building floor level.

5.04.04 Lux level to be considered for various areas are given in Annexure-D

5.04.05 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

5.04.06 Circuit loading of each lighting Panel shall be done in such a way that almost balanced loading in all the phases i.e. R, Y & B is achieved.

5.04.07 At least two sub circuits shall be used for illumination of a particular area.

5.04.08 Sub circuit loading of each lighting panel shall be restricted to 2000 Watts.

6.00.00 SPECIFIC REQUIREMENTS - SUPPLY

6.01.00 Equipment and Material

6.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

6.01.02 Equipment and materials furnished shall be complete and operative in all details.

6.01.03 All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

6.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

6.02.00 Lighting Transformers & Lighting Fixtures

6.02.01 Lighting transformers shall be dry type, indoor type dusty vermin proof having 415 V/415 V $\pm 2 \times 2.5\%$ with off load tap-changer on primary side. The vector-group shall be Dyn11. (The secondary side shall be solidly grounded through an additional neutral bushing exclusively used for grounding.) The casing of the transformer shall be grounded at least at two (2) points.

6.02.02 If necessary, apart from the main lighting transformers, separate small additional lighting transformers may be used at distance lighting points.

- 6.02.03 Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive and scratch resistant.
- 6.02.04 Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.
- 6.02.05 Fixture shall be suitable for 20 mm conduit entry and 16 SWG G.I. earth wire connection.
- 6.02.06 High bay fixtures shall have provision for vibration damper to ensure rated lamp life. Cost of each damper shall be separately indicated.
- 6.02.07 Fixture shall be furnished complete with lamps and integrally/non integrally or separately mounted control gear & accessories as applicable for different types of fixtures. These shall include holders, ballast, capacitor, starter, ignitors etc.
- 6.02.08 Fixtures shall be fully wired up to respective terminal blocks, suitable for loop in and loop out connection of PVC wires of following sizes :
- a) Lighting fixture : 2.5 mm² Copper
 - b) Flood Light fixture : 2x2.5 mm² Copper
- 6.03.00 **Lamps**
- 6.03.01 General lighting service (GLS) lamps shall be with clear glass and screwed caps.
- 6.03.02 All fluorescent lamp shall be bi-pin rotary type. Lamp holder shall be spring loaded, low contact resistance type and shall have resistance to wear. CFL and T5 fluorescent tube with electronic ballast or tri-phosphorous tube
- Fluorescent lamp will be used in indoor application having low height like 3 to 5 metres requiring good colour rendering. All control rooms, electrical panel room, auxiliary building, laboratories, office area, etc. will be provided with fluorescent lamp fixtures. The fluorescent lamp will be tubular, cool daylight type of 28W as per annexure.
- 6.03.03 Mercury/Sodium vapour lamp shall be colour corrected type with screwed cap.
- HPSV lamp has the advantage of very high efficiency (lumens/watt) and hence recommended for indoor application with elevation more than 4 meters such as TG Hall, Boiler & ESP platform, Pump House and all outdoor application such as area lighting, roads, boundary wall, etc. Flameproof fixtures will be used for hazardous areas with HPMV lamps. The HPSV/ HPMV lamps will be elliptical of rating 70W/150W/250W/400W as required depending on application.
- 6.03.04 Lamps shall be suitable for use in position and capable of withstanding small vibrations. Restrictions and special features, if any, shall be clearly indicated in the bid.

6.04.00 Ballast/Electronic Ballast

- 6.04.01 Ballasts shall be heavy duty, low loss, polyester-filled type with copper winding.
- 6.04.02 Ballast for Mercury/Sodium vapour lamp shall be provided with suitable tapping to set the voltage within range specified.
- 6.04.03 Ballasts shall be free from hum. Ballasts, which produce humming sound, shall be replaced, free of cost, by the Contractor.
- 6.04.04 In multi-lamp fixture, each lamp shall be provided with individual ballast.
- 6.04.05 Ballast windings shall have maximum operating temperature of 120°C without rated temperature rise marking.
- 6.04.06 Electronic Ballast shall be suitable for 220 V DC and also 240 V AC.
- 6.04.07 Electronic Ballast shall be compact, lightweight, high frequency electronic standard ballast for fluorescent lamps.
- 6.04.08 It shall be Flicker-free warm start, ideal for areas with high switching frequency.
- 6.04.09 Electronic Ballast shall be of such design that minimum 25% reduction in energy consumption at constant luminous flux compared with conventional gear.
- 6.04.10 Electronic Ballast shall not be caused to high harmonic distortion.
- 6.04.11 Electronic Ballast shall provide constant light independent of mains voltage fluctuation.

6.05.00 Lighting Panel/Distribution Boards

- 6.05.01 Lighting Distribution Boards/panels shall be metal-enclosed, cabinet type, fabricated from CRCA sheet steel minimum 2 mm thick, suitable for either wall/column mounting on brackets or floor mounting on channel sills.
- 6.05.02 Indoor Lighting Distribution Boards & Lighting Panels shall be dust and vermin-proof, IP-52 or better; outdoor panels shall be weather-proof with canopy, IPW-55 or better. The cubicle-housing transformer shall be minimum IP-42.
- 6.05.03 Lighting Distribution Boards and Lighting Panels shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.
- 6.05.04 Lighting Distribution Boards shall have provision of cable entry from bottom and, panels shall have provision of cable entry from top and bottom, as required, with removable gland plates. Necessary double compression type brass cable glands, tinned copper/Aluminium cable lugs are to be furnished.

6.05.05 Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Distribution Board and Lighting Panel for connection to ground conductor.

6.05.06 Each Lighting Distribution Board shall be complete with designation and caution notice plates fixed on front cover and a directory plate fixed on inside of the front cover. This directory plate shall contain details of the Lighting Panels being fed from the Distribution Board including their designation, location, loading etc.

Each Lighting Panel shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of each circuit.

The plates shall be of anodized aluminium with inscriptions indelibly etched on it.

6.05.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85°C. Minimum size shall be 25 x 6 mm.

6.05.08 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.

6.06.00 **Board/Panel Equipment**

6.06.01 Each Distribution Board shall consist of one dry type transformer housed in the cubicle voltmeter with selector switch, C.T. operated ammeter and incoming triple pole MCCB. Outgoing feeder from the Lighting Distribution Board shall have MCCB. Proper discrimination between outgoing MCCB of Lighting Distribution Board and downstream MCCB of Lighting Panel should be ensured.

6.06.02 Each panel shall have an incoming triple pole MCCB with neutral link and a number of outgoing miniature circuit breakers (MCB) as per annexure.

6.06.03 Board/Panel access door shall be interlocked with incoming MCCB such that the door can be opened only when the MCCB is in OFF position. Means shall be provided to defeat this interlock.

6.06.04 All MCCB shall be single throw, air break, heavy duty type having quick-make quick-break contacts. Fuses shall be HRC link type. Contactors shall be air break electromagnetic type. Push buttons shall be push to actuate type.

6.06.05 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

6.06.06 Time switch in street lighting panels shall be clock switch type with ON-OFF time setting facility, which shall ensure respective ON-OFF operation in every 24 Hours cycle. Voltmeter/Ammeter shall be of accuracy class 2.0 or better as per IS: 1248. Voltmeter/Ammeter selector switch shall be of reputed make.

6.07.00 **Receptacles**

- 6.07.01 Receptacles shall be heavy duty, complete with individual plug and switch as detailed in the annexure.
- 6.07.02 The conduit box of the receptacle shall be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG G.I. wire. Arrangement shall be provided inside the conduit box for grounding of third pin.
- 6.07.03 Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.
- 6.07.04 ~~Receptacles to be chosen for CHP system :~~
- ~~a) 5 Amp, 240 V, 2-Pole, 3-Pin type suitable for flush mounting in MCC & Control Room. The switch shall be of Piano-key type.~~
 - ~~b) 15 Amp. 240 V, 2-Pole, 3-Pin industrial type receptacle shall be provided in MCC room, control room, TP's, conveyor gallery/tunnel at an interval of 75 M along the length of the conveyor gallery/tunnel. Minimum one (1) no shall be provided in all equipment floor, TP's, Sub-Station, Cable Spreader Room, Crusher House, Pump House, etc. In each circuit from lighting panel maximum (5) nos. loop-in-loop-out connection shall be considered.~~
 - ~~c) 63 Amp, 415 V, 3-Ph., 4-Pin industrial type interlocked plug and switch with earthing contact receptacle shall be provided in MCC room, Control room,, conveyor tunnels/galleries, Wagon Tippler area and one (1) no. in all equipment floor of TP, Sub-Station, Cable Spreader Room, Crusher House, Pump House, etc.~~
- 6.08.00 **Fans & Regulators**
- 6.08.01 The fans shall have three well balanced blades, and shall be reasonably free from noise. Pedestal fans shall also be provided as per requirement.
- 6.08.02 Fan motor shall be totally enclosed type with copper winding and class E insulation.
- 6.08.03 Regulator shall have minimum five steps. Electronic regulator with smooth control is to be provided.
- 6.09.00 **Switch & Switch Board**
- 6.09.01 All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6 mm thick bakelite cover with brass fixing screws.
- 6.09.02 Switch boards/boxes located in control room and office areas shall be flush mounted type on brick wall with only the switch knob projecting outside.
- 6.09.03 Switch boards/boxes shall have conduit knock outs on the sides. Adequate provision shall be made for ventilation of these boxes.
- 6.09.04 Flush type receptacles where provided shall be so located that only the plug projects outside.

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6.09.05 Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

6.10.00 Lighting Poles & Flood Light Tower

6.10.01 Street Light Poles

- a) Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.
- b) The pole shall be coated with bituminous preservative paint on inside as well as embedded outside surface. Exposed surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in synthetic medium).

6.10.02 Flood Light Tower

- a) Flood light tower shall be a lattice structure with maintenance platform and approach ladder. All structural members and hardware shall be hot-dip galvanized.
- b) Structures shall be designed for an additional load of 1500kg for maintenance crew. Deflection under maximum wind pressure shall not exceed 1 in 360. Structural design shall be as per IS-800.

6.10.03 Lighting High Masts

Applicable standards :

The following shall be Reference Standards for loading of the High Mast:

- a) IS-875 (Part-III) 1987 - Code and practice for design loads for Structures.
- b) BSEN 10025/DIN 17100 - Grade of M.S. Plates.
- c) BS-5135/AWS - Welding
- d) BS.ISO 1461 - Galvanizing
- e) TR. No. 7200 of ILE - UK Specification for Mast and foundation.

Structure :

Lighting High Mast shall be of continuously tapered polygonal cross section, at least 20 sided, hot dip galvanized and presenting a good and pleasing appearance and shall be based on proven In-Tension design confirming to the standards referred to above, to give an assured performance, and reliable service. The structure shall be suitable for wind loading as per IS-875 Part-III, 1987. The masts dimensions shall be as per standards.

The Mast shall be of 30M height with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool,

luminaries, suitable aviation warning light, lightning along with necessary power cables within the mast. The mast shall be delivered only in three sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast.

6.11.00 Maintenance Equipment

6.11.01 The Contractor shall supply one (1) no. of wheel mounted adjustable aluminium ladder for the maintenance of street lights.

6.11.02 ~~For the maintenance of lighting fixtures within the power house, the contractor shall also supply four (4) nos. free standing adjustable aluminium ladder, adjustable from 5m. to 10m.~~

6.12.00 Special Requirement

6.12.01 All outdoor illumination fixtures, unless it is fed from photo cell/time switch controlled lighting panel, has to be provided with outdoor type local switches.

6.12.02 In all the air filtration units and air handling units, one marine type lamp (of 100 Watt approx.) shall be supplied and the wiring & fixing of the same has to be done by the contractor.

6.13.00 Lighting Cables & Wires

6.13.01 Lighting Cable shall be heavy duty, 1100 Volt grade, multicore stranded aluminium conductor, XLPE insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed with FRLS conforming to IS 1554.

6.13.02 Lighting wires shall be 1100 Volt grade, fire resistance PVC insulated, stranded conductor, single core cable conforming to IS 694, colour coded as below :

RED	for	R-Phase	BLACK	for	Neutral
YELLOW	for	Y-Phase	WHITE	for	+'Ve D.C.
BLUE	for	B-Phase	GREY	for	-'Ve D.C.

6.13.03 Wire size shall be as follows :

For point wiring beyond lighting panel : 10 Sq.mm. Aluminium.
i.e from lighting Panel to junction
box (main run) Stranded conductor

From Junction box to lighting fixture : 2.5 Sq.mm. Copper
Stranded conductor

6.14.00 Conduits and Accessories

6.14.01 Conduits shall be rigid steel, hot-dip galvanised, furnished in standard length of 3 metres, threaded at both ends.

- 6.14.02 Thickness of conduits up to and including 25 mm dia shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 20 mm.
- 6.14.03 Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushings at both ends.
- 6.14.04 Flexible conduits shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips and coated with PVC.
- 6.15.00 **Junction Box**
- 6.15.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanised, dust and damp proof, generally conforming to IP-55.
- 6.15.02 Junction boxes shall be complete with gasketed inspection cover, conduit knock out/threaded hub and terminal blocks.
- 6.15.03 Junction boxes for outdoor use shall be weatherproof IPW-55 and those for hazardous location shall be flame-proof type.
- 6.15.04 Junction boxes shall have following indelible markings :
- Circuit nos. on top
- Circuit nos. with ferrules (inside) as per drawing
- DANGER sign in case of 415V circuit
- 6.16.00 **Terminals**
- 6.16.01 Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outgoing wires.
- 6.16.02 Each terminal shall be suitable for connection up to 2 nos. 10 Sq.mm stranded aluminium conductors without any damage to the conductor or looseness of connectors.
- 6.17.00 **Portable Emergency Lighting Unit**
- The portable emergency lighting unit shall be complete with 6 volt storage battery (rechargeable), inverter, automatic charger, twin 6 watts fluorescents tube lamp and test switch. Contractor shall furnish make, type and catalogue.
- 6.18.00 **24 V Supply Module**
- ~~Each 24V A.C. supply module shall have one (1) no air cooled two winding, 500VA, 1-phase, 50HZ, 240/24V transformer with 6A (240V side) and 16A (24V side) HRC fuse and necessary 240V and 24V terminals for incoming and outgoing connections. The 240V terminals of 24V AC supply module shall be fed from respective lighting panels. A group of 6A, 24V AC receptacles located near Boiler access doors and condenser area shall be wired up from 24V side of each 24V A.C. supply module.~~

~~The 24V A.C. supply modules shall be sheet steel enclosed with louvers and shall be suitable for outdoor use. The 24V A.C. supply modules shall be suitable for wall/steel structure/column mounting. Switches shall be mounted at the front on sheet steel enclosure.~~

6.18.01 Minimum 15 nos. portable 24 V AC supply modules having sheet steel enclosure with louvers as per above shall be supplied for all the three units. 24V halogen automobiles lamps with reflector along with 1100 V, twin core PVC sheathed, 2.5 mm² stranded copper wire of 20 m lengths as handset.

Exact requirement will be finalized during detail engineering and accordingly the bidder shall furnish the same.

6.19.00 Nameplate

Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English as to clearly indicate their functions.

All lighting fixtures, receptacles, fans, junction boxes etc. shall be properly marked up indelibly with corresponding circuit numbers.

6.20.00 Samples

Owner reserves the right to call for samples if considered necessary and the same shall be submitted by the Bidder free and without any obligation.

6.21.00 Energy Saving System

6.21.01 Panels

The energy saving system panel shall consist of loss less reactance coils with voltage tapping, contactor to select the tap, Micro-processor based TIMER along with real time clock for activating the contactor at a pre-set time. The unit shall be programmable so that at a pre-set time contactor on the lower voltage tap can be selected and reduced voltage can be applied across the circuit. It shall also be possible to modify the setting at site, if required.

The capacity of panels shall be 25/30 kVA or more as required. This system shall be incorporated in normal AC panels and Emergency AC panels.

7.00.00 SPECIFIC REQUIREMENTS - SERVICES

7.01.00 Consumables and Hardware

7.01.01 The Contractor shall furnish all erection materials, hardware and consumables required for the complete installation.

7.01.02 The materials shall include but shall not be limited to the following :

- a) Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.

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- b) Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
- c) Materials : Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.
- 7.01.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.
- 7.02.00 **Testing Equipment**
- 7.02.01 The Contractor will provide such checking and testing equipment as test lamp, buzzer, 500-volt meggar, earth meggar, lux-meter etc. and also other testing equipment as required.
- 7.03.00 **Installation - General**
- 7.03.01 Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.
- 7.03.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- 7.04.00 **Lighting Fixtures**
- 7.04.01 Continuous rows of fluorescent tubes shall be mounted on a continuous M.S. angle for each row of lights.
- 7.04.02 In turbine hall, fixtures shall be mounted to maintain sufficient clearance from the overhead travelling crane trolley.
- 7.04.03 In boiler galleries, mounting height of fixtures shall be about 2500 mm from platforms except shown otherwise.
- Bracket for fixture mounting shall be fabricated at site from 40 mm conduits with a reducing socket to suit the fixtures and clamped on to the handrails. The fixing shall be strong enough to withstand vibration and high wind velocity.
- If a roof over platform is available, the fixture can be pendant mounted.
- 7.04.04 Floodlights shall be mounted on steel base facing the tentative direction shown on drawings. Fixing holes shall be provided with slot to turn the fixture about 5 Deg on both sides. Bolts shall be finally tightened with spring washer.
- The Contractor shall supply and install the steel base for fixing the flood light on the flood light towers.
- Terminal connection to the floodlight shall be made through PVC coated flexible metallic conduits.

- 7.04.05 Fixtures shall be mounted on sub-station structures with suitable clamps. No cutting or drilling of sub-station structures is permitted.
- 7.04.06 The fixtures after erection shall be marked up indelibly with corresponding circuit number for easy identification of lamp circuit.
- 7.05.00 **Receptacles**
- Receptacles shall be installed at locations shown in approved drawings.
- 7.06.00 **MLDB, EMLDB DCELDB and Lighting Panel**
- 7.06.01 MLDB, EMLDB DCELDB and Lighting panels shall be erected at the locations indicated in approved drawings.
- 7.07.00 **Street Lighting Poles**
- Erection of Street Lighting poles together with all its accessories including civil foundation work, installing lighting fixture, wiring and cabling work are included within scope of contractor.
- 7.08.00 **Conduit System**
- 7.08.01 In case of unarmoured cable, all conduits shall originate from the respective lighting panel and terminate in lighting fixtures, receptacles etc.
- 7.08.02 Exposed conduits shall be run in straight lines parallel to building columns, beams and walls as far as practicable. Unnecessary bends and crossings shall be avoided to present a neat appearance.
- 7.08.03 Conduit supports shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.
- 7.08.04 Conduits shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be fixed to the building steel by welding and to concrete or brick work by grouting as shown on drawings.
- Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.
- 7.08.05 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.
- 7.08.06 Spacing of embedded conduits shall be such as to permit flow of concrete between them and in no case shall be less than 40 mm.
- 7.08.07 Where conduits are run on cable trays they shall be clamped to supporting steel at an interval of 600 mm.
- 7.08.08 For directly embedding in soil, the conduits shall be coated with an asphalt - base compound. Concrete pier or anchor shall be provided where necessary to support the conduit rigidly and to hold it in place.

- 7.08.09 Conduits shall be installed in such a way as to ensure against trouble from trapped condensation.
- 7.08.10 Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.
- 7.08.11 Conduits shall be kept, wherever possible, at least 300 mm away from hot pipes, heating device etc. when it is evident that such proximity may impair the service life of cables.
- 7.08.12 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.
- 7.08.13 For long run, junction/pull boxes shall be provided at suitable intervals to facilitate wiring.
- 7.08.14 Conduits shall be securely fastened to junction box or cabinets, each with a locknut and insulated bushing inside the box and locknut outside.
- 7.08.15 Conduit lengths shall be joined by screwed couplers. Couplers shall be clearly cut.
- 7.08.16 Conduit joints and connections shall be made thoroughly water-tight and rust-proof by application of a thread compound which will not insulate the joints.
- White lead is suitable for application on embedded conduit and red lead for exposed conduit.
- 7.08.17 The Battery Room installation shall be made with acid fume proof conduits.
- 7.08.18 Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any conduit bend.
- 7.08.19 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and thoroughly grounded.
- 7.08.20 Lighting fixture shall not be suspended directly from junction box in the main conduit run.
- 7.08.21 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduits ends shall be plugged or capped to prevent entry of foreign material.
- 7.08.22 After installation the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.
- 7.08.23 In control rooms and office areas provided with false ceiling conduct run shall be concealed type, embedded in the walls.
- 7.09.00 **Wiring**

- 7.09.01 Wiring shall be generally carried out by PVC wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawing is permissible.
- 7.09.02 Wire shall not be pulled through more than two equivalent 90° bends in a single conduit run.
- 7.09.03 Wiring shall be spliced only at junction boxes with approved type connections or terminal strips. Maximum two wires can be connected to each way of the terminal block. Splicing of only one phase shall be done in a junction box.
- 7.09.04 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.
- 7.09.05 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/ junction box.
- 7.09.06 A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers shall be run through different conduits and Junction boxes.
- 7.09.07 Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.
- 7.09.08 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in form of switch or fuse.
- 7.10.00 **Cabling**
- 7.10.01 In outdoor areas, main runs from lighting panels shall be by means of XLPE cables, directly buried in ground or laid in trenches for the underground portion and through conduit for the over ground portion.
- 7.10.02 Buried cables shall be laid and covered with sand/ riddled earth, and protected from damage by bricks at sides and pre cast concrete slab at top. Buried cables shall have cable markers at 50M interval and projecting 150 mm above ground. At cable bends and joints markers shall be provided.
- 7.10.03 When buried cables cross road/railway track, additional protection to be provided in form of hume / G.I. pipe.
- 7.11.00 **Grounding**
- 7.11.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.
- 7.11.02 Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.
- 7.11.03 Panels/Boards shall be directly connected to ground grid by two nos. 35 x 6 mm G.I. flats (for panels) / two nos. 50x6 mm G.I. flats (for distribution boards).

- 7.11.04 All junction boxes, receptacles, lighting fixtures etc. shall be grounded with 16 SWG G.I. wire.
- 7.11.05 Each street lighting Pole shall be grounded at two points by two nos. 50x6 mm G.I flat risers from two (2) nos. earthing spike 40 mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2) nos. earthing terminals by 16 SWG GI wire. One 16 SWG G.I wire shall be taken up to the junction box from lighting fixtures and connected to grounding point.
- 7.12.00 **Foundation & Civil Works**
- 7.12.01 Equipment foundations, panel foundations and all other civil work will be provided by the Contractor.
- 7.13.00 **Excavation and Back Filling**
- 7.13.01 The Contractor shall perform all excavation and backfilling as required for buried cable and ground connections.
- 7.13.02 Excavation shall be performed up to the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.
- 7.13.03 The Contractor shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.
- 7.13.04 All excavation shall be backfilled to the original level with good consolidation.
- 7.14.00 **Steel Fabrication**
- 7.14.01 All supports, hangers & brackets shall be fabricated by the Contractor. Necessary steel shall be supplied by the Contractor.
- 7.14.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge.
- 7.14.03 Every effort shall be made to minimize the wastage of steel as far as practicable during fabrication. The wastage in no case shall exceed 3% of the total quantity of steel fabricated.
- 7.15.00 **Painting**
- 7.15.01 Street light poles shall be given two coats of aluminium paints after installation.
- 7.15.02 All steel fabrication shall be given two coats of redoxide primer followed by two coats of battleship Siemens gray RAL-7032.
- 7.15.03 All equipment shall be given touch-up paint as required after installation.
- 7.16.00 **Inspection & Testing**
- 7.16.01 On completion of erection works, the Contractor shall request the Engineer for inspection and tests with minimum fourteen (14) days advance notice.

7.16.02 The Engineer shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

7.16.03 The installation shall be then tested and commissioned in presence of the Engineer and put on trial run for stipulated contract period.

7.16.04 All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Contractor without any extra cost.

8.00.00 TESTS

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on lighting Distribution Boards/Panels shall include :

- a) Wiring continuity tests.
- b) High voltage and insulation tests.
- c) Operational tests.

8.02.00 Site Tests

8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove that the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.02.04 Illumination in different areas are as per designed lux level should be established.

8.03.00 Test Certificates

- a) Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.
- b) The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.
- c) Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

- 9.01.00 Drawings, data and manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in the General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.
- 9.02.00 **To be submitted with the Bid**
- 9.02.01 Make, type and catalogue number of lighting fixtures, lamps and accessories along with technical leaflets, data sheets, polar curves etc.
- 9.02.02 Typical outline drawings, showing constructional features, cable/ conduit entry, fixing arrangements etc of :
- a) Lighting Distribution Board & Panel/receptacles/junction boxes.
 - b) Street light pole.
- 9.02.03 Technical leaflets and data sheet on each piece of equipment / device such as MCB, switch fuse, MCCB, receptacle etc.
- 9.02.04 Type test certificates on lighting fixtures and lighting panels, transformer, ballast, power cables.
- 9.03.00 **To be submitted after Award of Contract**
- 9.03.01 Detail dimensional drawing showing constructional features, cable/ conduit entry, grounding, fixing arrangement etc. of:
- a) Lighting panels & distribution boards.
 - b) Receptacles & Junction boxes.
 - c) Street light poles.
 - d) Lighting fixture complete with lamps and accessories.
 - e) Non-integral/separate type control gearbox for lighting fixtures, as applicable.
- 9.03.02 Data sheets for lighting fixture, lamps, accessories with light distribution curves, co-efficient of utilization charts etc. Type and routine test certificates of transformer and cables.
- 9.03.03 Control schematic and wiring diagram of 415V AC/220V DC lighting panel with automatic changeover from AC to DC and vice-versa, 415V normal AC Street/area lighting panel with automatic ON/OFF feature.
- 9.03.04 Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of transformer and cables.
- 9.03.05 Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire routing.

- 9.03.06 Key Single Line Diagram for lighting distribution, board wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.
- 9.03.07 AS-BUILT lighting layout and erection drawings, properly incorporating the changes/alterations/field modifications, if any, as carried out at field along with circuit distribution schemes of all lighting panels, conduit and cable routing and as acceptable to the Owner.
- 9.03.08 Any other relevant drawings, data and manuals necessary for satisfactory installation, operation and maintenance.
- 9.03.09 The Bidder may note that the drawings, data and manuals listed are minimum requirement only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with his bid.

ANNEXURE-A

AVAILABLE POWER SUPPLY

1.0 System Voltage

Lighting equipment and accessories shall be designed for satisfactory operation from the following power supply sources:

- 1.1 A.C. Supply : 415 Volt, 3 phase, 50 Hz, 4 wire effectively grounded system.

Fault Level 50 KA r.m.s. symmetrical.

- 1.2 D.C. Supply : 220 V, 2 wire, ungrounded system.

Fault Level 25 * KA

2.0 Permissible Variation

Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variations as listed below:

- 2.1 A.C. Supply : Voltage $\pm 10\%$

Frequency $\pm 5\%$

Combined Voltage + Frequency 10% (absolute sum)

- D.C. Supply : Voltage 187 to 242 Volt.

* Indicative only; actual value will be decided by the Bidder after substantiating the same by calculation.

ANNEXURE-B

BROAD LIST OF AREAS TO BE ILLUMINATED

Purpose of this list is to give general guidance on major areas to be illuminated. The list is however not exhaustive. Illumination engineering shall be done by the Contractor based on the detail layout developed for rooms/areas during detail engineering and considering the guidance provided in Lighting Notes & Details.

1. Power House Building
2. Transformer Yard for GT, ST, UT, UAT & SATs.
3. GIS Building
4. Boiler Area for Units, Boiler galleries, platforms, stairs.
5. E S P
6. E.S.P Control Building
7. D.G. Plant Building (Part of Power House)
8. Service Building (Centralized Control Rooms)
9. C.W and ACW Pump House.
10. C.W. Chlorination Plant Building
11. Mill Bay
12. All roads in the transformer yard including approach roads (as will be finalized during detail engineering), general area.
13. Chimney
14. DG & Compressor BLDG.
15. Bottom & Coarse slurry P.H. & Elec. Room
16. ASW pump house & Elec. Room
17. Vacuum pump shed & MCC room
18. HFO & LDO pressurizing pump house
19. Fly ash conveying Comp. BLDG. & Elec. Room
20. Open yard
21. Store
22. Canteen
23. Work shop
24. Weight bridge
25. Cooling tower
26. DM plant
27. Wagon tippler
28. Wagon tippler CTRL. Room
29. Pent house
30. Crusher house

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31. CHP control room
32. Coal stock pile
33. HCSD & Art tank
34. Silo utility room
35. MCC cum ctrl. Room of HCSD system
36. F.O.P.H. & foam shed
37. ETP
38. In plant raw water reservoir & PH.
39. Fire station
40. Pretreatment & filtration plant
41. TTW & FW pump house
42. Plant area STP
43. ADMN. BLDG
44. Check post
45. Secondary gate
46. Ash gate
47. CW treatment BLDG
48. Loco shed
49. Peripheral road inside boundary wall.
50. Extension part of 400kV switchyard
51. Illumination of 6.5 metre wide RCC Road from proposed Ash dyke to existing Brick Plant (approx. 1200 metre length) in between 800E & 450W

NOTE: Illumination System Excluded from Bidder's Scope of Work:

1. Illumination System of outside plant boundary area of Ash Slurry / HCSD piping corridor and Illumination of Ash Pond I, II & III.
2. Illumination System of Fuel Oil Transfer pipe corridor along side of existing fuel oil transfer pipe corridor.
3. Illumination System of Railway Marshalling Yard

ANNEXURE-C

TYPES & BOM OF LIGHTING FIXTURES & LAMPS

Each lighting fixture shall be furnished complete with associated lamp, holder and control gear fully wired up. Control should include copper ballast, copper choke, capacitor starter, electronic-igniter (separate type), fuse connector block etc.

For well glass fittings for HPSV lamps higher wattage (250/400 W) floodlight luminaire, the control gear will be separate/non-integral type whereas for high bay, streetlight and mini flood light fixture, the control gear shall be integral type.

Sl. No.	Type	Wattage/ mains Voltage	Description
1.1	A(1)	1x100 W GSI 240 V AC 220 V DC	Industrial bulkhead luminaire, suitable with 1x GLS 100 W incandescent lamp. The luminaire should comprise of single piece pressure die cast aluminium housing and cover retaining frame made of LM6. The housing should be stove enameled white inside. The luminaire should have heat resistant toughened frosted gals cover along with a gasket made of EPR to ensure insect free satisfactory performance without ingress of water. A powder coated m.s. wire guard and all other accessories suitable for ceiling/wall mounting. (For use in inside area)
1.2	A(0)	1x100 W GSI 240 V AC 220 V DC	Well glass luminaire, dust proof & rain proof, light weight pressure die cast aluminium housing LM6 painted gray outside and white inside, with porcelain lamp holder (E-27) along with an earthing terminal heat resistant toughened clear glass cover with gasket made of EPR, pressure die cast Al. (LM6) ring hinge to the housing, powder coated ms wire guard mounting provision suitable for suspension by means of dia. 20 mm threaded GI pipe. The fixture should conform to degree of protection IP-65 (min)
1.3	DC (cmp)	1x100 W Comptalux 240 V AC 220 V Dc	Recessed downlight luminaire with asymmetric beam suitable for use in non-ventilated false ceiling. The luminaire should comprise sealing ring made of aluminium, pressure die cast. The frame with adjustable mounting clamps should be made of m.s. and zinc plated. The reflector should of high purity aluminium sheet electro chemically brightened and anodized. The luminaire should have E27 porcelain lamp holder fixed to nylon connector system pre-wired up to terminal block. The mounting clamps should be such so as to be adjusted according to the ceiling thickness for easy installation for different ceilings.
1.4	DA	2x28 W (228) Fluorescent lamp 240 V AC	Decorative type, Recessed mount, FTL Luminaires comprising epoxy powder coated CRCA housing, mirror optics aluminum anodized reflector, with anti-glare feature, louvers with aluminum transverse fins, completely wired with electronic ballast and starters, PF capacitor and connector suitable for 2x28W tubular fluorescent lamp.
1.5	DB	1x28	Decorative type, Recessed mount, FTL Luminaires

Sl. No.	Type	Wattage/ mains Voltage	Description
		Fluorescent lamp 240 V AC	comprising epoxy powder coated CRCA housing, mirror optics aluminum anodized reflector, with anti-glare feature, louvers with aluminum transverse fins, completely wired with electronic ballast and starters, PF capacitor and connector suitable for 1X28 tube lamp.
1.6	DC	2x9 CFL 240 V AC	Decorative type, Recessed mount, CRCA housing, aluminum anodized reflector, fitted with painted aluminium lamelle suitable for 2x9W PL lamp.
1.7	DF	2x28 Fluorescent lamp 240 V AC	Industrial, Ceiling or Suspension mount, FTL Luminaries comprising of stove enamelled steel sheet reflector, completely wired with electronic ballast and starters, PF capacitor and connector suitable for 2x28W tubular fluorescent lamp.
1.8	FP	1x125W HPMV 240 V AC	Flame proof luminaire : Well glass non-integral flame proof fixture die cast aluminium LM 6 housing enamel heat resistant toughened well glass, with hot dip galvanized wire guard a spi-gotted terminal cum lamp holder plate made of LM6 with an E 27 type porcelain lamp holder 1X19mm BSC/ET cable entry with an option ceiling/wall mounting or suspension with a bracket or an eye bolt Separate flame proof control gear enclosure of die cast aluminium housing with cover, chain suspension for the cover assembled with all accessories and loop in loop out arrangement. All termination within the control gearbox should be suitable for explosive environment. The fixture & control gear should be suitable for use in hazardous area zone-1& zone-2 as per IS 5572(part I)-1978 and for explosive environment of gas Group-IIA & II B as per IS 2148-1981. Degree of protection IP55
1.9	LB	1x150/250W HPSV 240 V AC	Well glass luminaire, dust and jet proof, light weight housing made of corrosion resistant die cast aluminium alloy in conjunction with separate control gearbox. Housing should be stove enameled gray outside white inside after application of epoxy base primer, a porcelain lamp holder (E-40 type) prewired up to terminal block located inside the housing along with earthing arrangement. The luminaire should suitable for suspension by means of threaded G.I. Pipe of 20 mm bore and also for 'j' bracket mounting. A glass cover made of heat resistant glass (annealed) provided with EPR gasket encased in die cast aluminium ring hinged to the housing. Should have external vitreous enameled reflector. Degree of protection-IP 55 (min) for luminaire and IP 54 (min) for control gear.
1.10	LD	1x70W HPSV 240 V AC	Well glass luminaire, similar to above but suit able for 70W HPSV lamps. Luminaire shall have external M.S. sheet steel vitreous enameled reflector with integral control gear, degree of protection IP 65 (Minimum).
1.11	HB	1x250/400 W	High bay luminaire industrial closed version luminaire with

Sl. No.	Type	Wattage/ mains Voltage	Description
		HPSV 240 V AC	painted die cast aluminium housing accommodating vibration proof E-40 lamp holder with a provision for adjustment to obtain narrow/wide beam distribution, painted die cast aluminium mounting tray accommodation ballast, capacitor and igniter all pre wired up to the terminal block, a chain to suspend the housing, a cable entry gland or grommet for entry of incoming cable and an internal earthing. An anodized spun aluminium spacer between housing and reflector and high purity/a glass reflector electro-chemically brightened and anodized flat toughened glass fixed to the reflector by toggle to suspend the glass cover, an eye bolt of Zinc plated and passivated M.S. Degree of protection IP-52 (min)
1.12	MB (150)	1x150W 240 V AC	Medium bay luminaire- similar to HB above expect suitable for lower mounting height with 150W HPSV lamps.
1.13	EL	1x20W 240 V AC	Escape lighting luminaire with "EXIT" sign type i.e. EXIT sign always visible fitted with 1x20 fluorescent tube. Each luminaire shall be self contained 6 volt battery, battery charger unit. Normally the luminaire shall be ON continuously through 240V AC supply. When AC supply goes OFF the in built battery & inverter system automatically takes on to ignite luminaire for duration of two & half (2½) hours. The battery shall be maintenance free and shall be trickle charged when 240 V AC mains supply is available.
1.14	NY	1x150/250W HPSV 240 V AC	Street light luminaire-weather proof having housing made of corrosion resistant LM6 die cast aluminium epoxy powder coated in an attractive grey colour out side. Specially developed pot mirror optimized for use with tubular lamp of high purity aluminium, electrochemically brightened and anodized, copper etc. accommodated in gear compartment of housing. Long life neoprene gasket, to avoid entry of insects, cover made of acrylic. Degree of protection-IP-43 suitable for 150 SV lamps.
1.15	DL	2x28W Fluorescent 240V AC	Industrial, Ceiling or Suspension mount, FTL Luminaries comprising of stove enamelled steel sheet reflector, completely wired with electronic ballast and starters, PF capacitor and connector suitable for 2x28W tubular fluorescent lamp. Lighting fixtures are totally enclosed corrosion proof type.
1.16	DE	1x28W/2x28W Fluorescent 240V AC	Dust, Drip & water proof FTL luminaries, aluminum housing with canopy, acrylic cover, completely wired with electronic ballast and starters, PF capacitor and connector suitable for 1x28W / 2x28W tubular fluorescent lamp.
Note:1	The supply also includes associated junction boxes, brackets, supports, hangers, and wires wherever applicable.		
2.0	LIGHTING BOARD/PANEL		
2.1	MLDB & EMLDB		415 V A.C. Indoor type Lighting distribution board with transformer (details in Annexure-E), 415 V, 200A, 3 ph, 4 wire bus, one 200A triple pole switch as incomer, 8 Nos. 100A, TP & N switch and fuse as outgoing feeders.
2.2	DCELDB		Indoor type Emergency Lighting Distribution Board with

Sl. No.	Type	Wattage/ mains Voltage	Description
			100A, 415 V TPN bus, 1 no. 100A TP & N switch fuse as A.C. incomer, 1 no. 100A D.P. switch fuse as D.C. incomer and 18 nos. 20A, 2 pole MCB with back-up fuse as outgoing feeders complete with auto change over control circuit, push button, indication lamp, etc. with provision for manual override & test facility to test all emergency circuit.
2.3	LP-1		415 V A.C. Indoor type Lighting Panel with 415 V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch as incomer, 18 nos. 20A, 240 V, 1 pole MCBs as outgoing feeders.
2.4	LP-2		415 V A.C. Indoor Lighting panel with 415 V, 3ph, 4W bus & one 63A TP & N Switch as incomer and 12 nos 20A , 240V 1 pole MCBs as outgoing feeder.
2.5	LP-3		415V A.C. Indoor type Lighting Panel with 415V, 63A, 3 ph, 4 wire bus, one (1) no. 32 A TP&N switch as incomer, 6 nos. 20A, 240V, 1 pole MCBs as outgoing feeders.
2.6	SLP		415 V A.C. Outdoor type Panel with 415 V, 100A, 3 ph, 4 wire bus, one 100A TP & N switch as incomer, 18 nos. 20A, 240V, 1 pole MCBs as outgoing feeders.
			The lighting panel shall be provided with 63A contactor, frequency compensated timer switch, photo-cell switch push- buttons for automatic control of street/area lighting with provision for manual override.
2.7	DCELP		Indoor type emergency lighting panel with 240V bus, one no 20A switch fuse as incomer and 6 nos 16A two pole MCB with back up fuse as outgoing feeders.
2.8	FLP		Outdoor, lookable type Isolating switch of 415V, 32A, 3 ph, 4 wire TP & N. with 2 mm sheet steel/cast iron cubicle.
3.0	RECEPTACLE		
3.1	RA		6A, 240 V, 2 pole, 3 pin with third pin earthed, suitable for flush mounting in office areas and control room. the switch shall be also flush mounted piano type.
3.2	RB		16A, 240V, 2 pole, 3 pin with third pin earthed, wall/ column mounted, metal clad gasketed construction, 20mm conduit entry, screwed metal cover tied to it by a metal chain, weatherproof suitable for indoor/outdoor installation.
3.3	RC		63A, 415 V, 3 phase, 4 pin interlocked plug and switch with earthing contact, wall/column mounted, metal clad gasketed construction, weatherproof, suitable for loop-in/loop-out connection of 4/C-35 Sq.mm XLPE cable. These shall be fed from AC Distribution Board/Station MCC.
3.4	RD		125 A, 415 V, 3 phase 5 pin interlocked plug & switch with fifth pin earthed, wall/column mounted metal clad gasketed construction, weatherproof, suitable for loop in and loop out connection of 3-1/2C -95 Sq.mm XLPE cable. These shall be fed from A.C-Distribution Board/Station MCC.
4.0	CEILING FANS		
4.1	FA		1200 mm sweep ceiling fan with regulator, down rod and

Sl. No.	Type	Wattage/ mains Voltage	Description
			canopy.
4.2	FB		1400 mm sweep ceiling fan with regulator, down rod and canopy.
5.0	LIGHTING POLES		
5.1	TA/TB		Single arm/double arm swaged and welded steel pole with junction box and all accessories.
6.0	SWITCHBOARD		
6.1	S-1		Switch board with 1-5A switch.
6.2	S-2		Switch board with 3-5A switch and 1-5A receptacle.
6.3	S-3		Switch board with 6-5A switch and 1-5A receptacle.
7.0	MISCELLANEOUS ITEMS		
7.1	M1		10 m high car wheel mounted aluminium ladder.
7.2	M2		Adjustable free-standing aluminium ladder height adjustable from 5 m to 10 m.
7.3	M3		Portable Emergency light set complete with one 20W tube light, battery, battery charger and all other accessories.
7.4	M4		24 Volt Supply Module with all accessories.

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ANNEXURE-D

ILLUMINATION LEVEL

Sr. No.	Area/Structure	Average Illumination Level in Lux.	Type of Fixture / Luminaire	Type of Lamp
1.0	Turbine Generator Building :			
1.1	General Auxiliary Equipment Areas	100	Industrial Well Glass	70W/150W HPSV/125 W HPMV Lamp
1.2	Cable Spreader Room	70	Industrial type fluorescent lamp with vitreous enamel reflectors	Fluorescent tube (T5) with electronic ballast.
1.3	All Switchgear Room Area	200	Industrial type fluorescent lamp with vitreous enamel reflectors	Fluorescent tube (T5) with electronic ballast.
1.4	TG Building Operating Floor	200	Industrial Integral high bay	250 W/400W HPSV / HPMV lamp
1.5	Main Control Rooms	400	Decorative recessed mounted with mirror optics aluminum anodized reflector	2 x 28W FTL
1.6	Battery Rooms	200	Industrial Corrosion proof luminarie.	2 x 28W FTL.
1.7	Unloading and Maintenance bay	250	Industrial integral high bay	250 W / 400W HPSV / HPMV lamp
2.0	Boiler Area :			
2.1	Boiler area and platforms	100	Dust proof / dust tight integral well glass luminaire	70 W HPSV/ 125W HPMV lamp
2.2	Coal Bunker and Mill bay area	100	Dust proof / dust tight integral well glass luminaire	1 x 80 W /125 W HPMV lamp
2.3	ESP areas and Platforms	100	Dust proof / dust tight integral well glass luminaire	70 W HPSV/ 125W HPMV lamp
2.4	ESP Control Room	400	Decorative recessed mounted with mirror optics aluminum anodized reflector	2 x 28 W FTL.
Sl. No.	Area/Structure	Average Illumination Level in Lux.	Type of Fixture / Luminaire	Type of Lamp
3.0	Transformer Yard :			
3.1	General	20	General purpose flood light	250 W/400 W HPSV lamp
3.2	Near equipment	50	Dust proof / dust tight	1 x 70 W HPSV

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Sr. No.	Area/Structure	Average Illumination Level in Lux.	Type of Fixture / Luminaire	Type of Lamp
			integral well glass	lamp
4.0	GIS Building :			
4.1	General Indoor Area	200	Industrial type fluorescent lamp / Industrial Integral high bay or Medium bay	fluorescent tube (T5) with electronic ballast/250 W/400W HPMV lamp
4.2	Near Local Control panel	300	Industrial type fluorescent lamp	fluorescent tube (T5) with electronic ballast
5.0	Various Off-site Buildings :			
5.1	Equipment Room / Switchgear Rooms	200	Industrial type fluorescent lamp with vitreous enamel reflectors up to mounting height of 3.5 M or Industrial medium bay integral luminaire for mounting heights between 3.5 to 8 M.	fluorescent tube (T5) with electronic ballast
5.2	Pump Houses	200	Industrial well glass	70 W HPSV/ 125W HPMV lamp
6.0	Cooling Water Pump House Area :			
6.1	Cooling Tower Area	30	Industrial well glass	70 W HPSV/ 125W HPMV lamp
6.2	CW PH	200	Industrial medium bay integral luminaire for mounting heights between 3.5 to 8 M	70 /150 W HPSV or 150 / 250 W HPMV lamp
7.0	Road & Yard Lighting:			
7.1	Main Roads	20	Integral type street Lighting luminaire with aluminium reflector	150 /250W HPSV lamp
7.2	Secondary Roads	10	-do-	-do-
7.3	Perimeter (Compound) Lighting	10	-do-	-do-
8.0	Service Building, Canteen, Annex. Building etc.			
8.1	Main Office /Staff Room	300	Decorative recess mounted mirror optics aluminum anodized reflector	2 x 28W FTL
8.2	Non-Office /Service Areas	300	Decorative recess / surface mounted/ Suspended type mirror optics	Fluorescent tube (T5) with electronic ballast.
9.0	General :			
9.1	Corridors, Walkways,	70	Industrial type	Fluorescent tube

Sr. No.	Area/Structure	Average Illumination Level in Lux.	Type of Fixture / Luminaire	Type of Lamp
	Staircase, Lockers etc.		fluorescent lamp with vitreous enamel reflectors	(T5) with electronic ballast.
9.2	Toilets, Wash Rooms, etc.	70	Commercial channel mounted box type	Fluorescent tube (T5) with electronic ballast.
10.0	Extension part of 400kV SWYD :			
10.1	Control Room	400	Decorative recessed mounted with mirror optics aluminum anodized reflector	2 x 28W FTL
10.2	Switchgear/Electrical Equipment room	200	Industrial type fluorescent lamp with vitreous enamel reflectors up to mounting height of 3.5 M or Industrial medium bay integral luminaire for mounting heights between 3.5 to 8 M.	fluorescent tube (T5) with electronic ballast
10.3	Battery Room	200	Industrial Corrosion proof luminarie.	2 x 28W FTL.
10.4	Outdoor Operating Area	50	General purpose flood light	250 W/400 W HPSV lamp
10.5	General Outdoor Area	20	General purpose flood light	250 W/400 W HPSV lamp
11.0	CHP Area			
11.1	Transfer Point, Conveyor gallery, pent house, tunnel, Crusher house & Wagon Tippler	100	Dust proof / dust tight integral well glass	70 W HPSV/125 W HPMV lamp
11.2	Coal Stack yard/ Open area/ Marshalling yard	10	General purpose flood light & Integral type street Lighting luminaire with aluminium reflector	150 W/250 W/400 W HPSV lamp

* Medium bay fixtures shall be used where the room height is 8 M. Otherwise high bay fixtures are to be used.

Lux level for A.C. Emergency lighting in control room shall be 50 and for other areas 20 lux.

Lux level for main road lighting shall be 20 and for secondary road shall be 10 lux.

Lux level for D.C. Emergency lighting in control room shall be 50 and for other areas 20 lux.

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ANNEXURE-E
RATINGS AND REQUIREMENTS
OF
LIGHTING TRANSFORMER

Type	:	Cast Resin Dry Type
KVA rating	:	100 KVA
Voltage rating	:	415 V/415 V
Cooling	:	AN
P.U. Impedance	:	0.045 $\pm$ 10%
Voltage control	:	Off load tap switch/link with change of $\pm$ 5% in step of 2.5% tapping full capacity.
Vector Group	:	Dyn11
Class of Insulation	:	F (155°C)
Maximum Temperature rise over 50°C. ambient in winding by resistance	:	90°C
Neutral	:	Solidly grounded.

The secondary neutral of the transformer shall be brought out for getting a grounded 4wire supply. Each transformer shall be routine tested and one transformer shall be type tested in accordance with relevant standard.

The transformer shall be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.

The transformer shall be mounted inside sheet steel enclosure, which shall be an integral part of Lighting Distribution Board.

ANNEXURE-F
FITTINGS AND ACCESSORIES
OF
LIGHTING TRANSFORMER

Each transformer shall be equipped with fittings and accessories as listed below :

1. 150 mm dia. winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip and alarm
2. Handling and lifting lugs both for enclosure and core-coil assembly.
3. Jacking pad for core-coil assembly.
4. Inspection cover for cable and box.
5. Door handle operated safety limit switch with 1NO + 1NC contact.
6. Ground bus.
7. IP-55 junction box.
8. Rating and terminal marking plates.

Note

All indication, alarm, trip contacts provided shall be rated for 0.5A at 220 V D.C. and 5A at 240 V A.C.

ILLUMINATION SYSTEM NOTES & DETAILS

					 GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
					 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					JOB NO. K9213R SCALE : NIL	
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)					DWG. NO. K9213R-DWG-E-0800 SHT.-COVER	
SKB	MS	BR	0	04.07.12	REV. 0	
APPVD.	REVWD.	CHKD.	REV.	DATE		

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 	Document Name : Notes & Details - Illumination	Rev. No. : 00
	Document No. :	

REFERENCES:

- IS-732: Code of Practice for Electrical Wiring Installation
- IS13408: Code of Practice for the Selection, Installation and Maintenance of Electrical Apparatus for Use in Potentially Explosive Atmospheres (Other than Mining Applications or Explosives Processing and Manufacture)
- National Building Code (NBC)
- National Electrical Code (NEC)
- Indian Electricity Rules

NOTES & DETAILS:

1. The electrical installation work shall meet the requirements of Indian Electricity Rules, relevant IS codes of practice and safety codes, as amended upto date. In addition, other rules or regulations as applicable to the work shall be followed.
2. These notes and details shall be read and construed in conjunction with the illumination layout and drawings.
3. Except specifically approved by site office, installation of exposed conduits, mounting of lighting fixture etc. shall be taken up only after all other services such as Piping, Air Ducting Cable Tray/ Busduct Hangers, Structural Bracing etc. in a particular area have been installed.
4. Unless otherwise shown, the mounting heights of lighting fixtures and accessories shall be generally as follows:
 - a) i) Low Bay lighting fixtures in general indoor : 3500 mm from bottom to finished areas of industrial plants floor.
 - ii) Medium Bay type fixtures : 3500 to less than 8000 mm from bottom to finished floor.
 - iii) High Bay type fixtures : 8000 mm and above from bottom to finished floor.
 - iv) General indoor lighting for residential, : 2700 mm from bottom to finished commercial area floor.
 - b) Lights over door openings : 300 mm bottom of fixture above top of

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- opening.
- c) In boiler platform/Platform around reactor : Pendant below Boiler
Platform or with column, reformer, cracker etc. brackets from handrail 2000
mm above platform.
 - d) Receptacles :
 - i) In control room/office : 450 mm from finished floor to
center
 - ii) Elsewhere : 900 mm from finished floor to
center
 - e) Local Switches : 1500 mm from finished floor
to center
 - f) Lighting Panels : 1800 mm from finished floor
to center
 - g) Ceiling Fans : 200 mm above lighting
fixtures
5. Unless otherwise noted, all lighting fixtures shall be fed from respective lighting panels. Normal AC lighting panels will be fed from Main Lighting Distribution Boards (MLDB). Emergency AC lighting panels will be fed from Emergency Main Lighting Distribution Boards (EMLDB). DC Emergency Lighting Distribution Boards (DCELDB) will be fed from Main DC Distribution Boards.
6. All outdoor lighting poles / towers shall be provided with fuse / MCBs at their base while receiving incoming cable.
7. Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in the form of switch or fuse.
8. All exposed conduit runs in battery rooms, chemical feed station area, water treatment building etc. shall be suitably painted with electrolytic / chemical proof paints.
9. The entire metallic conduit system whether embedded or exposed, shall be electrically continuous and thoroughly grounded.
10. Lighting fixtures shall not be suspended directly from junction box in the main conduit run.
11. Separate conduit shall be used for wiring lighting circuits of different lighting distribution system such as normal AC lighting / emergency AC lighting/emergency DC lighting / low voltage lighting.
12. A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers and different batteries (D.C. source) shall not be run through same conduit and junction boxes.
13. Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.

14. Wires / cable shall be spliced only at junction boxes with ring-tongue lugs or approved equal.
15. For cable/wire numbering, PVC sleeve with cable / wire tag number of different colour code shall be used.
16. For roads/outdoor areas, main runs from street/area lighting panels shall be by means of AYWY/AYFY/A2XFY cables, directly buried in ground with proper protection as per details shown or through duct bank.
17. When buried cables cross road/railway track, additional protection to be provided in form of Hume/G.I. pipe/HDPE pipes. GI pipes / Hume pipes shall not be used for single core cable run.
18. All wiring in hazardous areas shall be carried out either with armoured cables or cables drawn in screwed solid or seamless conduit.
19. For classified hazardous areas (other than mines) having flammable gases and vapors only, all the items and accessories of illumination system shall have enclosure as approved for the hazardous area classification (Zone 0, Zone 1 and Zone 2) as per code of standard IS-5571 and 5572.

Lamps containing free metallic sodium (e.g. low pressure sodium vapour lamps) are not permitted for use in hazardous areas.

20. In underground mines, the lighting system shall have a mid or neutral point connected with earth and the voltage shall not exceed 125 volts between phases.

On the surface of a mine or in an open cast mine, the voltage may be raised to 250 volts, if the neutral of mid point of the system is connected with earth and the voltage between the phases does not exceed 250 volts.

Where portable hand-lamps are used in under ground working of mine, the voltage shall not exceed 30 volts.

21. Number of receptacles in an area shall be decided based on utility of this area. However, unless otherwise noted, number of receptacles shall generally be selected based on following guidelines:
 - a) For Residential Building, 6A and 16/6A single-phase receptacles shall be considered as per NBC.
 - b) For general area (e.g. Electrical room, Pump room, Control room) of Plant Building, 16/6A receptacle shall be considered.
 - c) One (1) number 63A three-phase receptacle shall be provided at each generator busduct area, at each generator-transformer area, station-transformer area, transformer area at switchyard, boiler area, major pump rooms.
 - d) 63A three-phase receptacle shall be provided at each turbine bay, at each boiler area, etc. for use of welding machine.

- e) In industrial plants, 63A three-phase receptacles shall be decided based on the application requirement.
- f) 24V single-phase receptacle shall be used in boiler platform area and vessels platforms (e.g. reactor, reformers etc.) hazardous classified area. The number shall be decided based on application and area.

22. Unless otherwise noted, the minimum size of cables, wires, conduits, junction boxes shall generally be as below :

A CABLES

- i) From Main Lighting Distribution Boards to 400V normal AC Lighting Panels : 1 x 3-1/2C, 95 mm² Al, XLPE
- ii) From Emergency Main Lighting Distribution Boards (EMLDB) to 400V Emergency AC Lighting Panels. : 1 x 3-1/2C, 95 mm² Al, XLPE
- iii) From Main Lighting Distribution Boards (MLDB) to 400V AC/220V DC Emergency Lighting Distribution Boards (DCELDB) : 1 x 3-1/2C, 95 mm² Al, XLPE
- iv) From 220V Main DC Distribution Boards to 220V DC Emergency Lighting Distribution Board (DCELDB) : 1 x 2C, 35 mm² Al, XLPE
- v) From PMCC/MCC/DB to 100A 3 phase receptacles : 1 x 3-1/2C, 95 mm² Al, XLPE
- vi) From PMCC/MCC/DB to 63A 3 phase receptacles : 1 x 4C, 35 mm² Al, XLPE
- vii) From SLP (Street Lighting Panel) to tower junction box : 1 x 4C, 16 mm² Al, XLPE
- viii) From SLP to light pole junction box (for single phase) : 1 x 2C, 16 mm² Al, XLPE
- ix) From SLP to light pole junction box (for three phase) : 1 x 4C, 16 mm² Al, XLPE

B WIRES

Wires shall generally be PVC insulated 650V grade. Each wire shall be of following sizes :

- | | |
|---|---|
| i) From lighting panels (LPs) to junction boxes (JBs) | : 10 mm ² Al (stranded) or 6 mm ² Cu (stranded) |
| ii) From junction boxes (JBs) to lighting fixtures | : 2.5 mm ² Cu |
| iii) From junction boxes to flood light fixtures | : 2.5 mm ² Cu. |
| iv) From Lighting Panels to 24V AC supply modules (complete with 230/24V built-in transformer & 24V receptacle) | : 10 mm ² Al (stranded) or 6 mm ² Cu (stranded) |
| v) Point wiring of light/ ceiling fan/exhaust fan/ call bell | : 1.5 mm ² Cu (stranded) |
| vi) 230V, 6A receptacle | : 1.5 mm ² Cu (stranded) |
| vii) From LP to 230V, 16/6A 1 st receptacles | : 4 mm ² Cu (stranded) |
| viii) From 230V, 16/6A 1 st receptacle to 230V 16/6A second receptacle | : 2.5 mm ² Cu (stranded) |
| ix) From LP to 230V, 20/16A receptacles | : 4 mm ² Cu (stranded) |
| x) 230V window/split AC starter unit upto 2 Ton capacity | : 4 mm ² Cu (stranded) |
| xi) Circuit wiring from LP to switchboard | : 2.5 mm ² Cu (stranded) |
| xii) From street light panel to lighting pole JB (if conduit used) | : 16 mm ² Al (stranded) or 6 mm ² Cu (stranded) |
| xiii) From street light pole junction box to street light fixture | : 2.5 mm ² Cu (stranded) |

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C CONDUITS

- a) Unless otherwise noted, in residential and commercial building, PVC conduit shall generally be used for concealed conduiting purpose both in masonry wall as well as in concrete portion. Two numbers 18 SWG GI fish wires shall be drawn inside each conduit while embedding in concrete portion. At both ends of each conduit a minimum 400 mm length of fish wires shall be kept by coiling, for pulling of wires. All exposed conduits above false ceiling shall be Galvanized Iron (GI) or Enameled Iron (EI).
- b) In plant area GI conduit shall be used at surface. Unless otherwise noted, in Non-Plant building rigid PVC conduit shall be used at surface.
- c) Conduits shall generally be Galvanized Iron (GI) / Enameled Iron (EI) / PVC of following minimum sizes:

Wire size		Conduit size				
		20mm	25mm	32mm	40mm	50mm
Maximum no. wires admissible for conduit	i) 10 sq. mm AL	--	2	5	7	8
	ii) 6 sq. mm Cu	2	3	7	--	--
	iii) 4 sq. mm Cu	3	5	10	--	--
	iv) 2.5 sq. mm Cu	4	6	10	--	--
	v) 1.5 sq. mm Cu	4	6	10	--	--

of

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D JUNCTION BOXES

	Conduit Size	Junction box size (mm)		
	(mm)	4-way	3=Way	Straight Through
90 Deg.				
88 Φ	i) 20/25	150 x 150 x 100	150 x 100 x 100	88 Φ
	ii) 32/40	254 x 200 x 127	254 x 200 x 127	150 x 150 x 100 ---
	iii) 50	254 x 200 x 127	254 x 200 x 127	254 x 200 x 127 ---

23. All lighting panels/distribution boards, junction boxes, receptacles fixtures, conduits, etc. shall be grounded in compliance with the provision of I.E. rules and as detailed below :

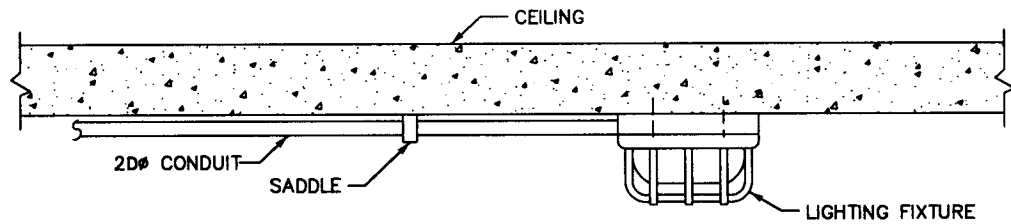
- i) Lighting Panels : 35 x 6 mm G.S. Flat
- ii) Distribution Boards : 50 x 6 mm G.S. Flat
- iii) Power Receptacles Junction Boxes etc. : 12 SWG G.I. wire
- iv) Lighting fixtures, switches conduits, etc. : 16 SWG G.I. wire
- v) Street Light Poles and Towers for floodlighting : 25 x 3 mm G.S. Flat

24. A continuous ground conductor of 16 SWG G.I. wire shall run along each exposed metallic conduit run and bonded to it every 600 mm.

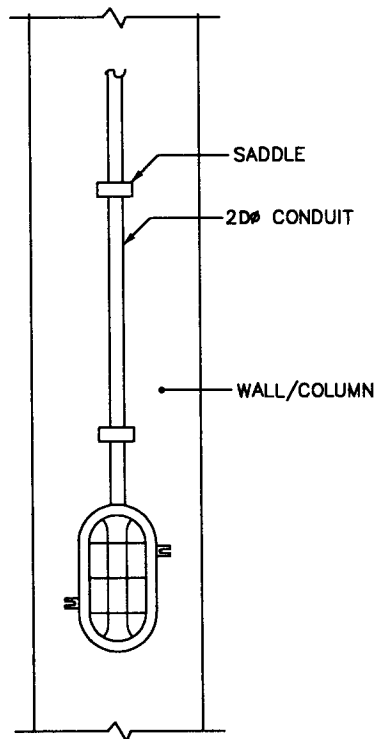
25. For a run of conduit partly or wholly embedded, PVC insulated stranded copper conductor wire, as ground conductor shall run through the conduit.

26. Typical details of lighting fixtures, other lighting system components and their mounting arrangement as shown herein are for general guidance only. The type no. of some make has been referred in the various drawings only to indicate desired appearance and construction features of the fixture. The contractor has to design the same fulfilling the requirement of the specification.

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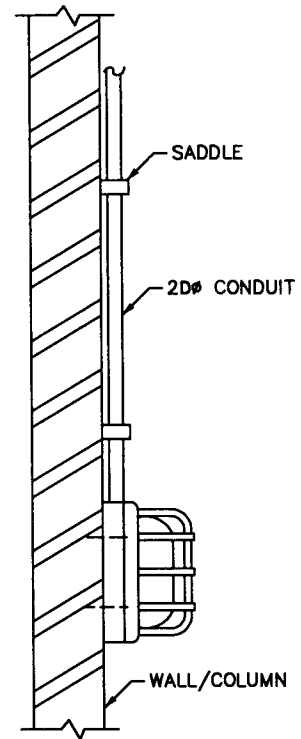


CEILING MOUNTING



VIEW - AA

WALL/COLUMN MOUNTING



VIEW - AA

BULKHEAD LUMINAIRE

BULKHEAD LUMINAIRE WITH 1DDW/6DW GLS OR 9W CFL

[EQ. PHILIPS TYPE NXC 1D1(1xGLS 6DW)/FXC 1D1(1xPL-S 9W)]

[EQ. BAJAJ TYPE BJD1DD(1xGLS 1DDW)/BJBE19(9W CLF)]

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VADODRA, GUJARAT

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

SKB	MS	BR	0	04.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

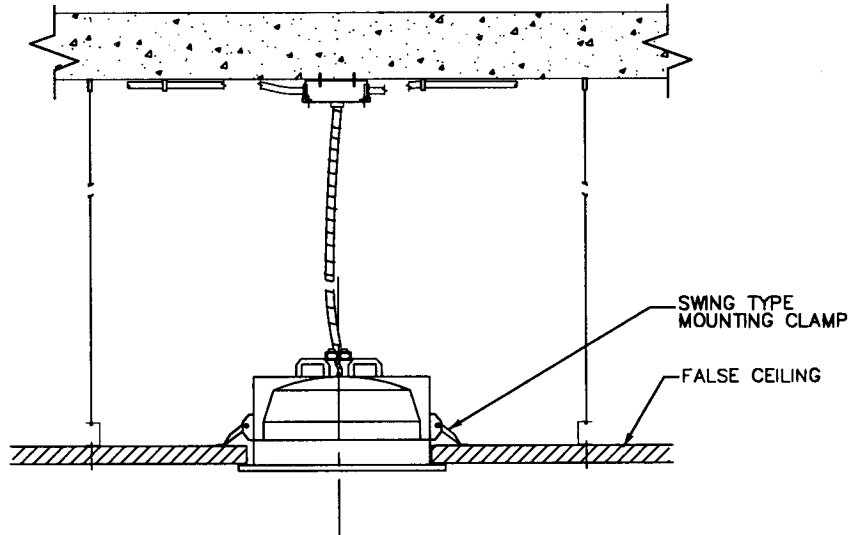
JOB NO. K9213R

SCALE : NIL

DWG. NO. K9213R-DWG-E-0800

SHT. 09

REV. 0



RECESS MOUNTED DOWNLIGHT

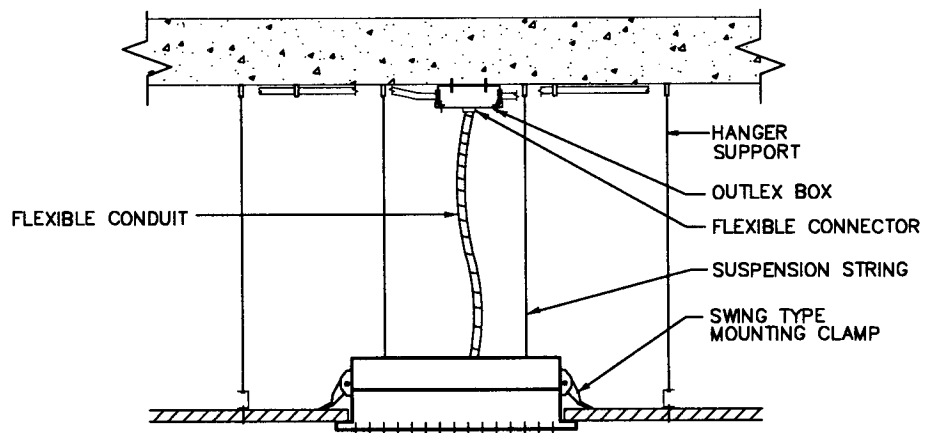
NOTE:-

RECESSED, DECORATIVE, SINGLE/TWIN LAMP HORIZONTAL MOUNTING CLF DOWN LIGHT

[EQ. BAJAJ TYPE BJDR110(CFL 1x10W), BJDR113(CFL 1x13W), BJDR118(CFL 1x18W), BJDR29(CFL 2x9W)]

[EQ. BAJAJ TYPE BJDR210LH(CFL 2x10W), BJDR213LH(CFL 2x13W), BJDR218LH(CFL 2x18W)]

[EQ. PHILIPS TYPE FBH120(PL-C 1X10W), FBH150/145(PL-C 1X13W, 1X18W, 2X13W, 2X18W)]



RECESS MOUNTED MIRROR OPTICS LUMINAIRE

RECESSED, DECORATIVE, MIRROR OPTICS LUMINAIRE
SUITABLE FOR 2X9W, 2X11W, 2X18W, 2X36W
& 3X36W PL-L/CFL-L LAMPS AND WITH
HIGH FREQUENCY ELECTRONIC GEAR.

[EQ. PHILIPS TYPE FBS SERIES]

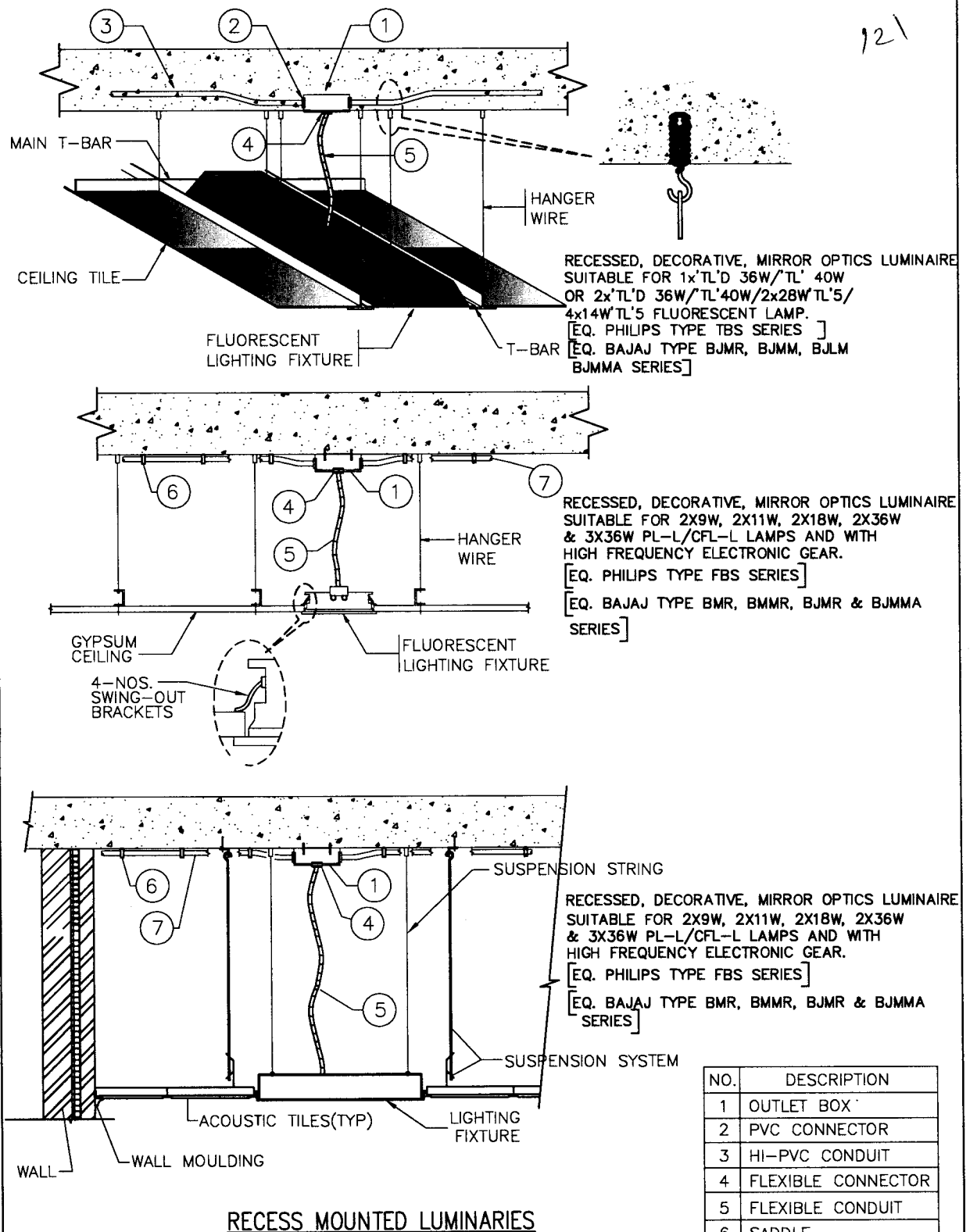
[EQ. BAJAJ TYPE BMMR, BJMR & BJMMA SERIES]

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					TITLE:
					ILLUMINATION SYSTEM
					NOTES & DETAILS
					PROJECT:
					1x800 MW SUPERCRITICAL THERMAL POWER PLANT
					(UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)
SKB	MS	BR	0	04.07.12	
APPVD.	REVWD.	CHKD.	REV.	DATE	

JOB NO.	K9213R	SCALE :	NIL
DWG. NO.	K9213R-DWG-E-0800	REV.	0
		SHT.	10



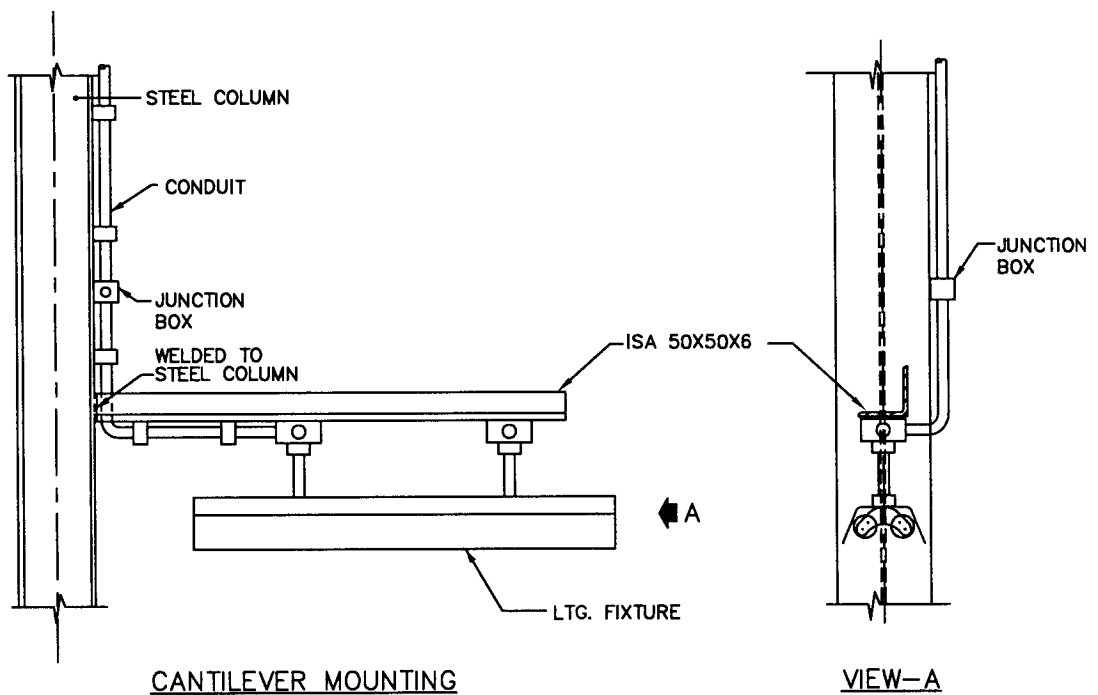
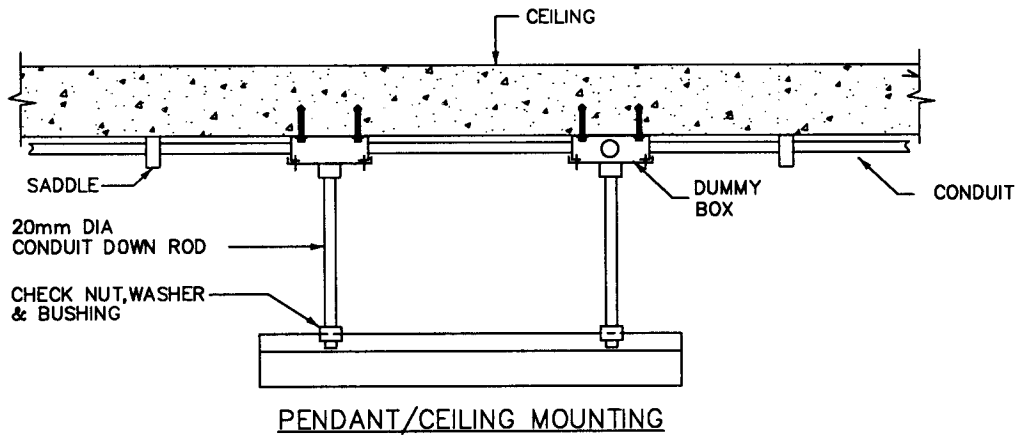
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APPVD.	REVWD.	CHKD.	REV.	DATE	

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

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 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
JOB NO. K9213R	SCALE : NIL
DWG. NO. K9213R-DWG-E-0800	REV. 0
SHT. 11	

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INDUSTRIAL REFLECTOR LUMINAIRE SUITABLE
FOR 1x'TL'D 36W/'TL' 40W , 2x'TL'D 36W/'TL'40W ,
1x'TL'5 28W OR 2x'TL'5 28W FLUORESCENT LAMP.
[EQ. PHILIPS TYPE TKC24/TMS122]
[EQ. BAJAJ TYPE BJIV/BTIA]

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JOB NO. K9213R SCALE : NIL

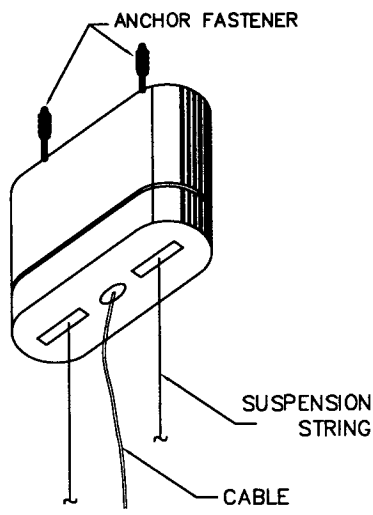
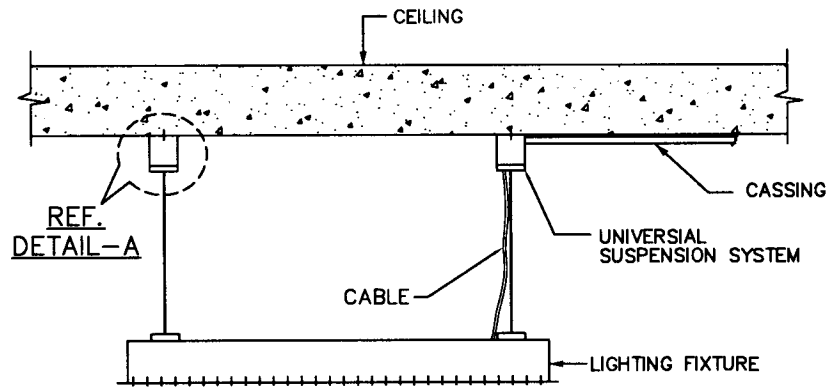
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SHT. 12

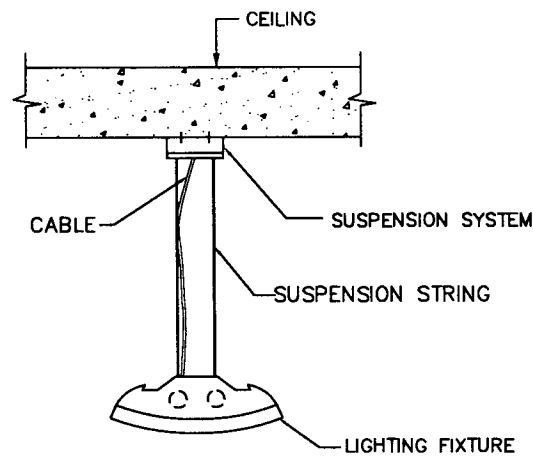
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS				
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)				
SKB	MS	BR	0	04.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

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VIEW-XX



UNIVERSAL SUSPENSION SYSTEM
DETAIL-A



VIEW - XX

SUSPENDED LUMINAIRES

SUSPENDED MOUNTED FUNCTIONAL AND DECORATIVE MIRROR OPTICS LUMINAIRES
WITH 'TL'D/'TL'-5' FLOURESCENT LAMP WITH 1X36W 'TL'D/2X36W 'TL'D OR 1X18W 'TL'-5/2X36W 'TL'-5
[EQ. PHILIPS TYPE TPS 498]

SKB	MS	BR	0	04.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE:
ILLUMINATION SYSTEM
NOTES & DETAILS

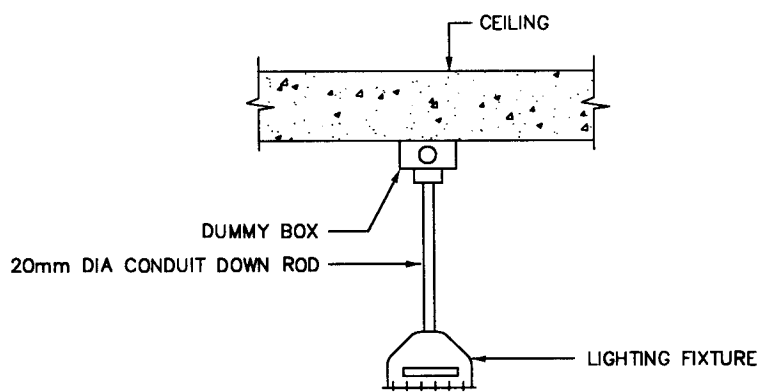
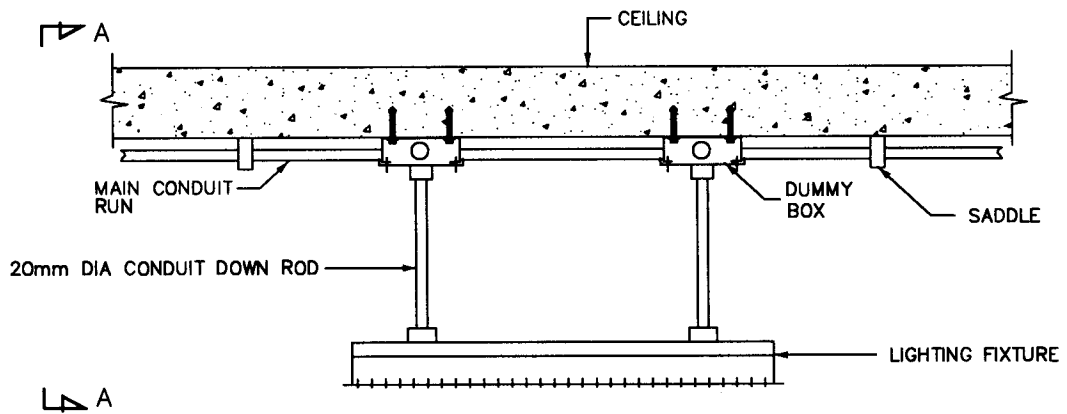
PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GSCL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
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DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

JOB NO.	K9213R	SCALE :	NIL
DWG. NO.	K9213R-DWG-E-0800	REV.	0
		SHT. 13	

115



VIEW - A-A
PENDANT/CEILING MOUNTING

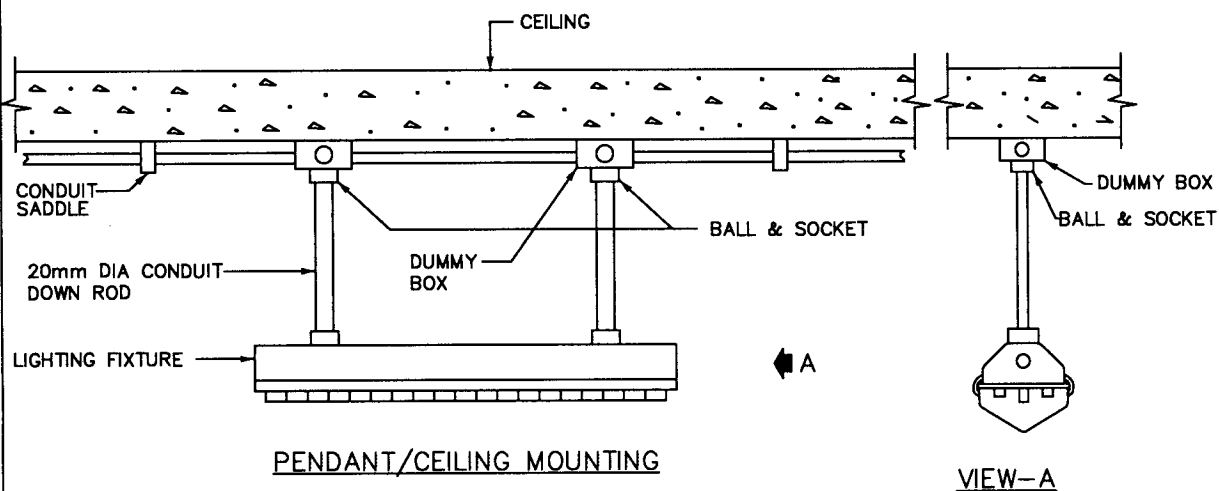
WIDESPREAD MIRROR OPTICS LUMINAIRES WITH 'TL'D/'TL'
FLOURESCENT LAMP WITH 1X36W 'TL'D/2X36W 'TL'D'
[EQ. PHILIPS TYPE TCS 306]
[EQ. BAJAJ TYPE BTSM218/236 WEB2]

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)		JOB NO. K9213R	SCALE : NIL
SKB	MS	BR	0	04.07.12			DWG. NO. K9213R-DWG-E-0800	REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE			SHT. 14	

A4_DD (9-96) [210x297]

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DUST AND JET WATER RESISTANT
FOR SINGLE AND TWIN TL-D AND T-5 WITH
1X36W 'TL'D/1X18W 'TL'D/2X36W 'TL'D/2X18W 'TL'D/
1X28W 'TL'5/2X28W 'TL'5
[EQ. PHILIPS TYPE TCW 097]
[EQ. BAJAJ TYPE BJI236/240DP]

A4_DD (9-96) [210x297]



SKB	MS	BR	0	04.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
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JOB NO. K9213R

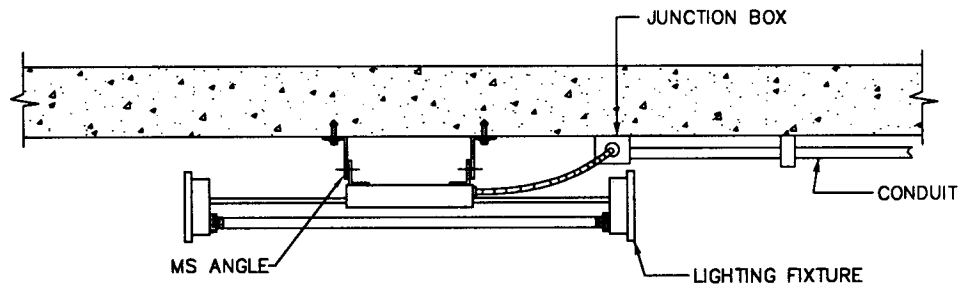
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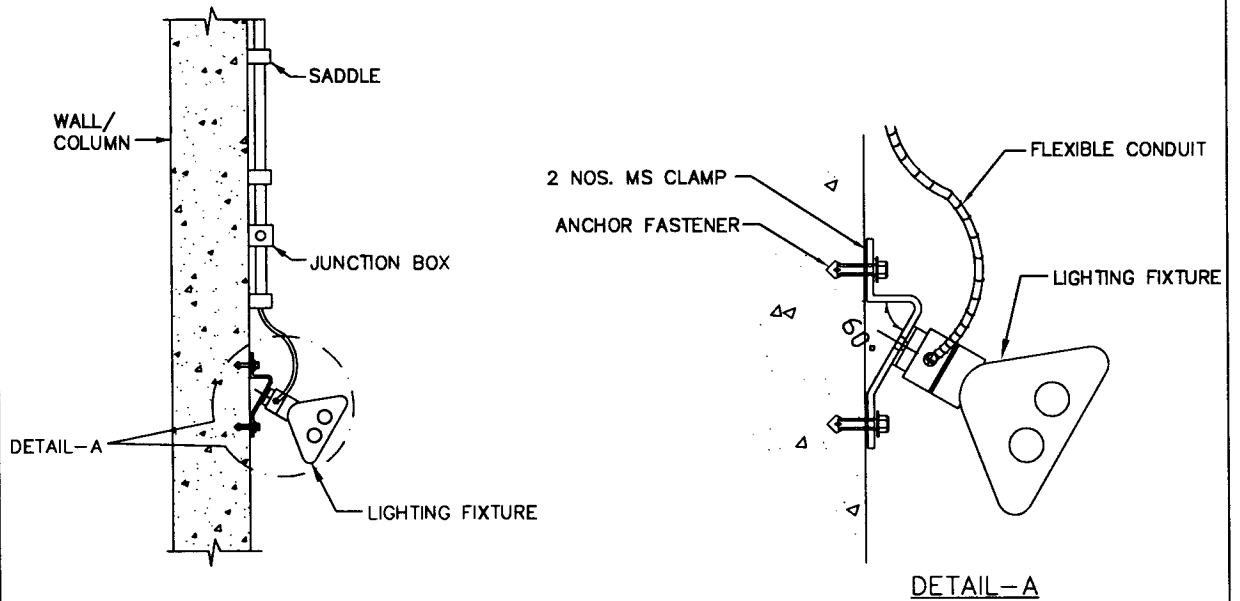
REV. 0

SHT. 15

11C



CEILING MOUNTING



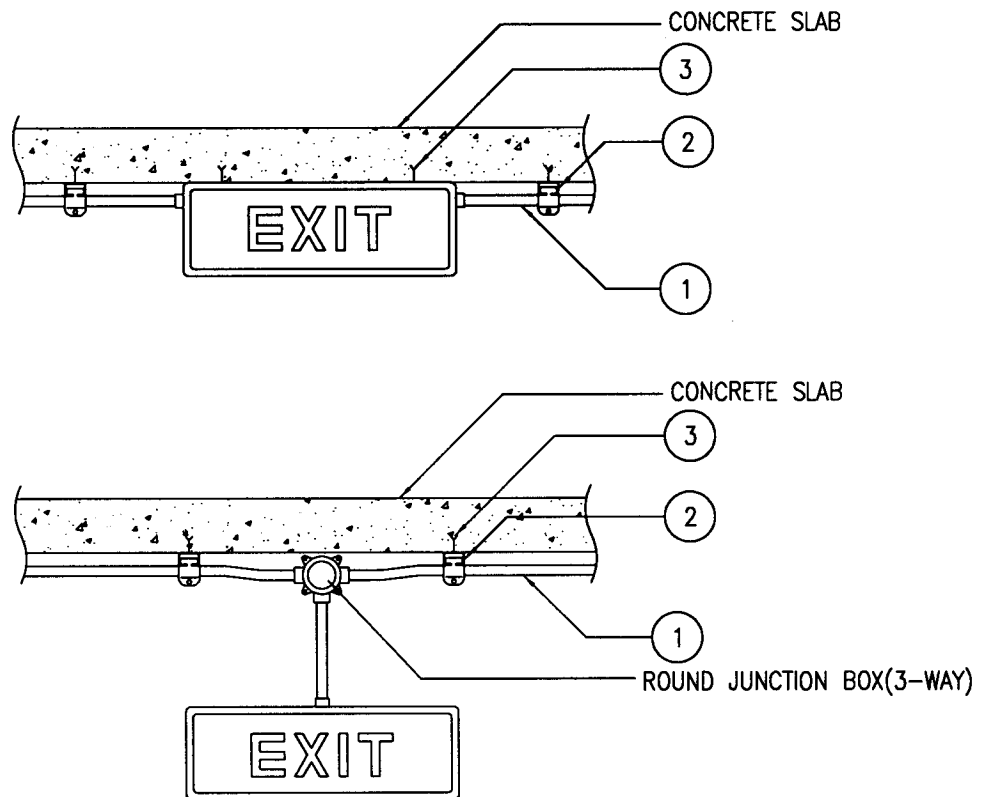
WALL/COLUMN MOUNTING

CORROSION-RESISTANT INDUSTRIAL BATTEN FOR 'TL'/'TL'D
FLOURESCENT LAMP WITH 2X36W 'TL'D/2X40W 'TL'
[EQ. PHILIPS TYPE TMX 95]
[EQ. BAJAJ TYPE BJI240VP]

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		JOB NO. K9213R		SCALE : NIL	
					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		DWG. NO. K9213R-DWG-E-0800		REV. 0	
SKB	MS	BR	0	04.07.12					SHT. 16	
APPVD.	REVWD.	CHKD.	REV.	DATE						

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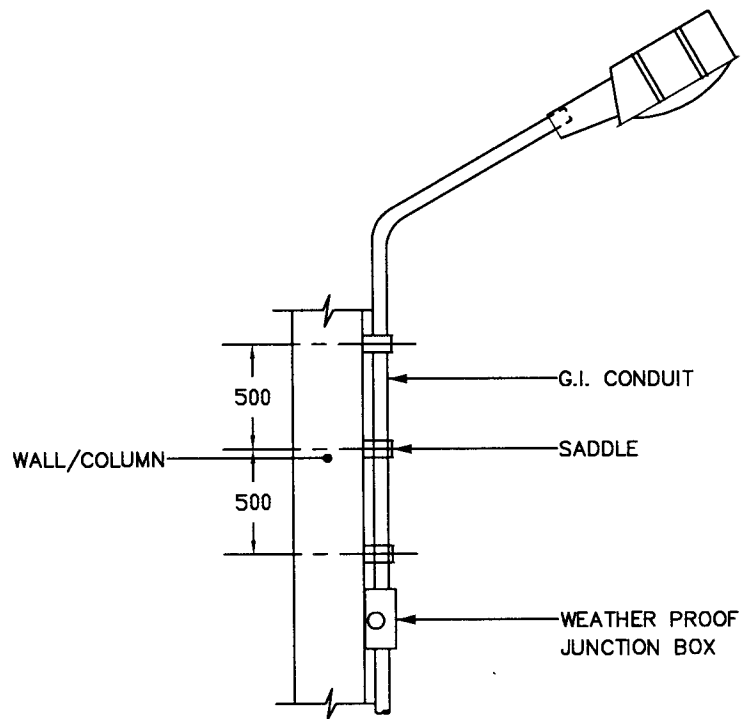


NO.	DESCRIPTION
1	H.D.G STEEL CONDUIT
2	UNISTRUT CHANNEL W/PIPE CLAMP
3	CON'C EXPANSION ANCHOR

EXIT LIGHT MOUNTING DETAIL

					 GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
					 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					JOB NO. K9213R SCALE : NIL	
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)					DWG. NO. K9213R-DWG-E-0800 REV. 0 SHT. 17	
SKB	MS	BR	0	04.07.12		
APPVD.	REVWD.	CHKD.	REV.	DATE		

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MOUNTED IN BUILDING WALL/COLUMN

ROAD LIGHTING LUMINAIRE WITH
18/36W TLD, 28/54 TL5,
SON 70/150/250/400W,
HPL-N 125/250W LAMP

[PHILIPS TYPE SRP/TRC/HGS/
HRP/SRX/SGP SERIES OR EQUAL]
[BAJAJ TYPE BJMIP SERIES OR EQUAL]

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VADODARA, GUJARAT

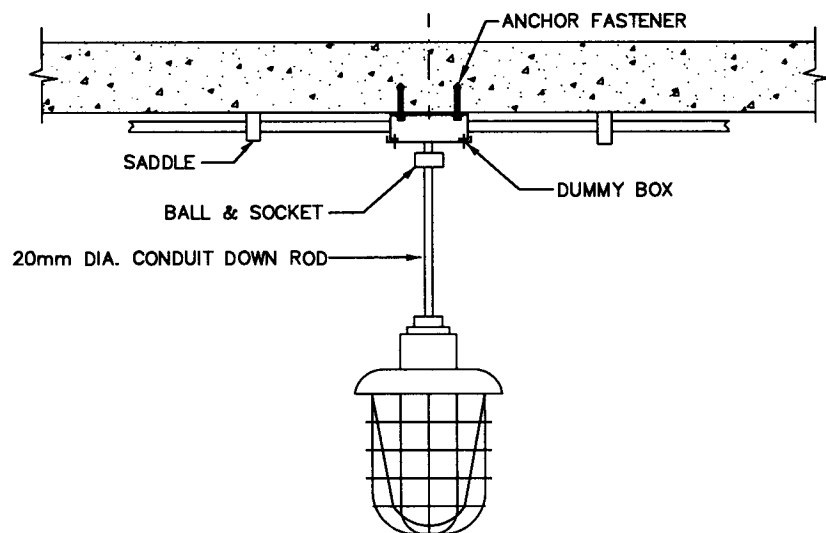
SKB	MS	BR	0	04.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

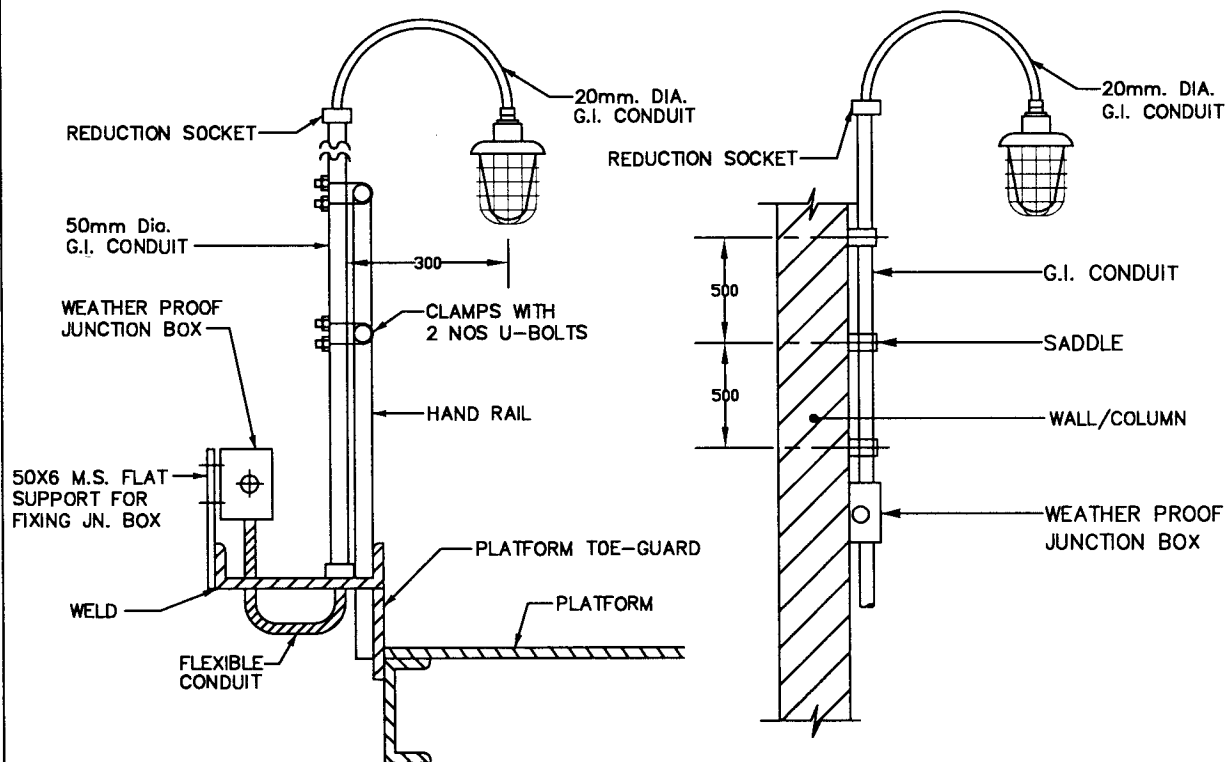
PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

JOB NO. K9213R **SCALE :** NIL
DWG. NO. K9213R-DWG-E-0800 **REV.** 0
SHT. 18



PENDANT/CEILING MOUNTING



PLATFORM MOUNTED

MOUNTED IN BUILDING
WALL/COLUMN

INDOOR WELL GLASS INDUSTRIAL LUMINAIRE WITH NON INTEGRAL CG BOX

[EQ. PHILIPS TYPE NDC 21(1XGLS 500W, 1XHPL-N 250W, 1XSON 150W OR 250W)]

[EQ. PHILIPS TYPE NDC 203(1XGLS 200W, 1XHPL-N 80W OR 125W, 1XSON 70(I) OR 70W(E), ML-N 160W)]

GS ECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

SKB	MS	BR	0	04.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

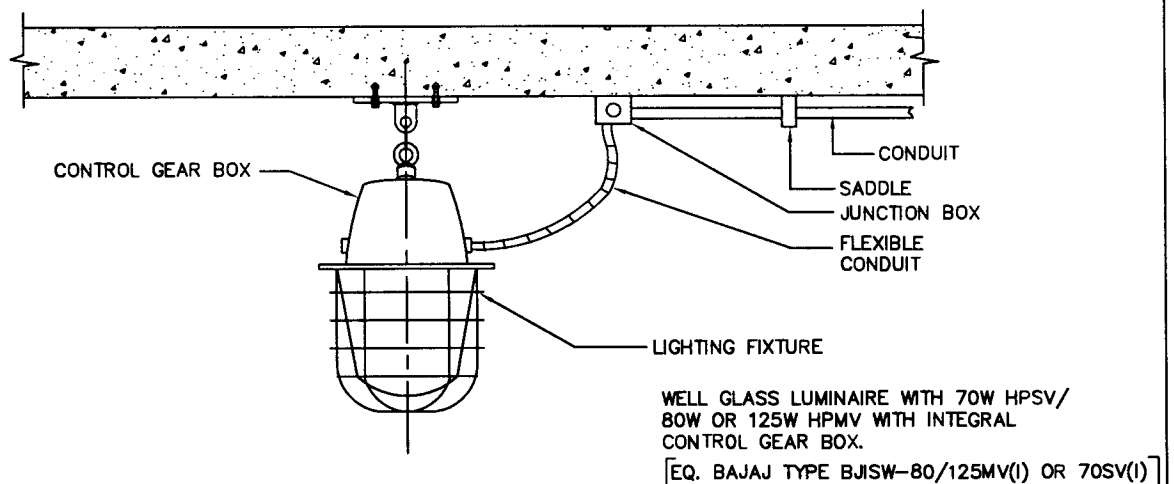
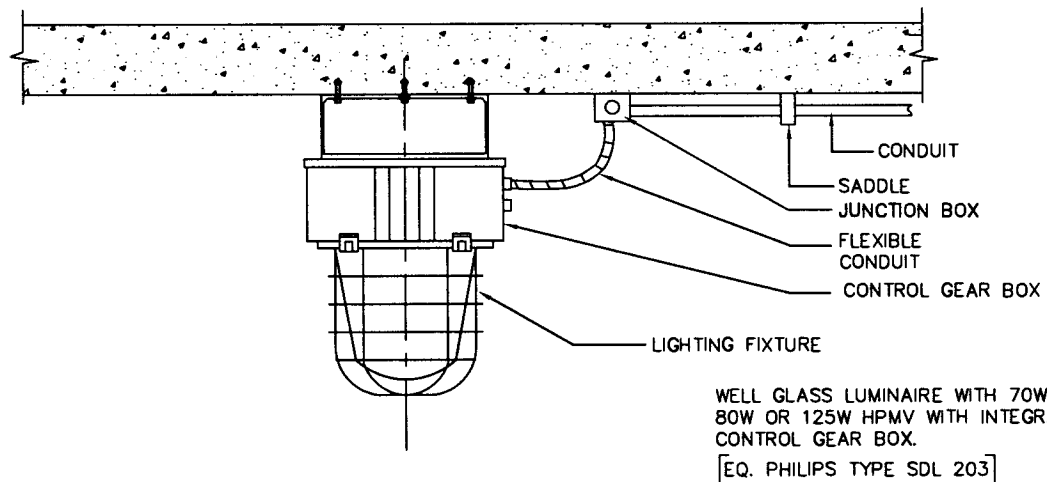
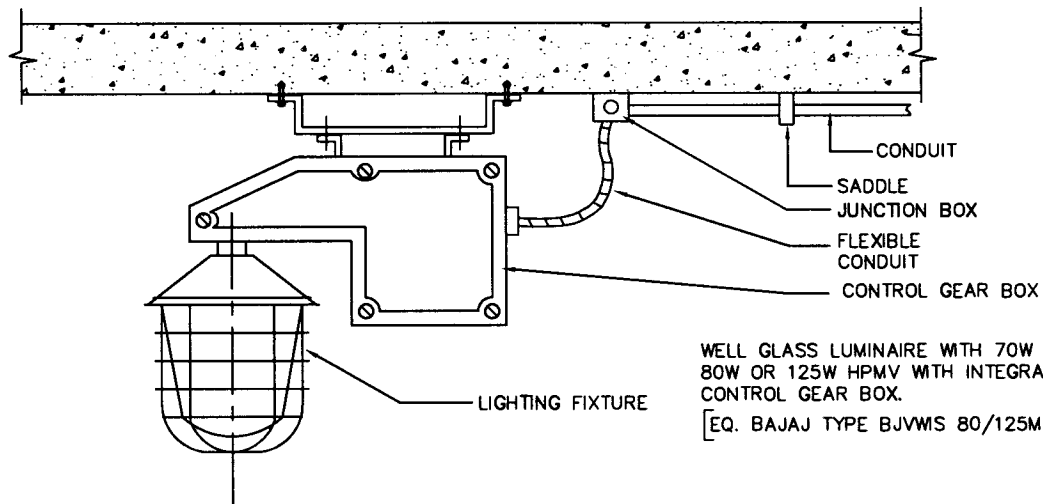
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SCALE : NIL

DWG. NO. K9213R-DWG-E-0800

REV. 0

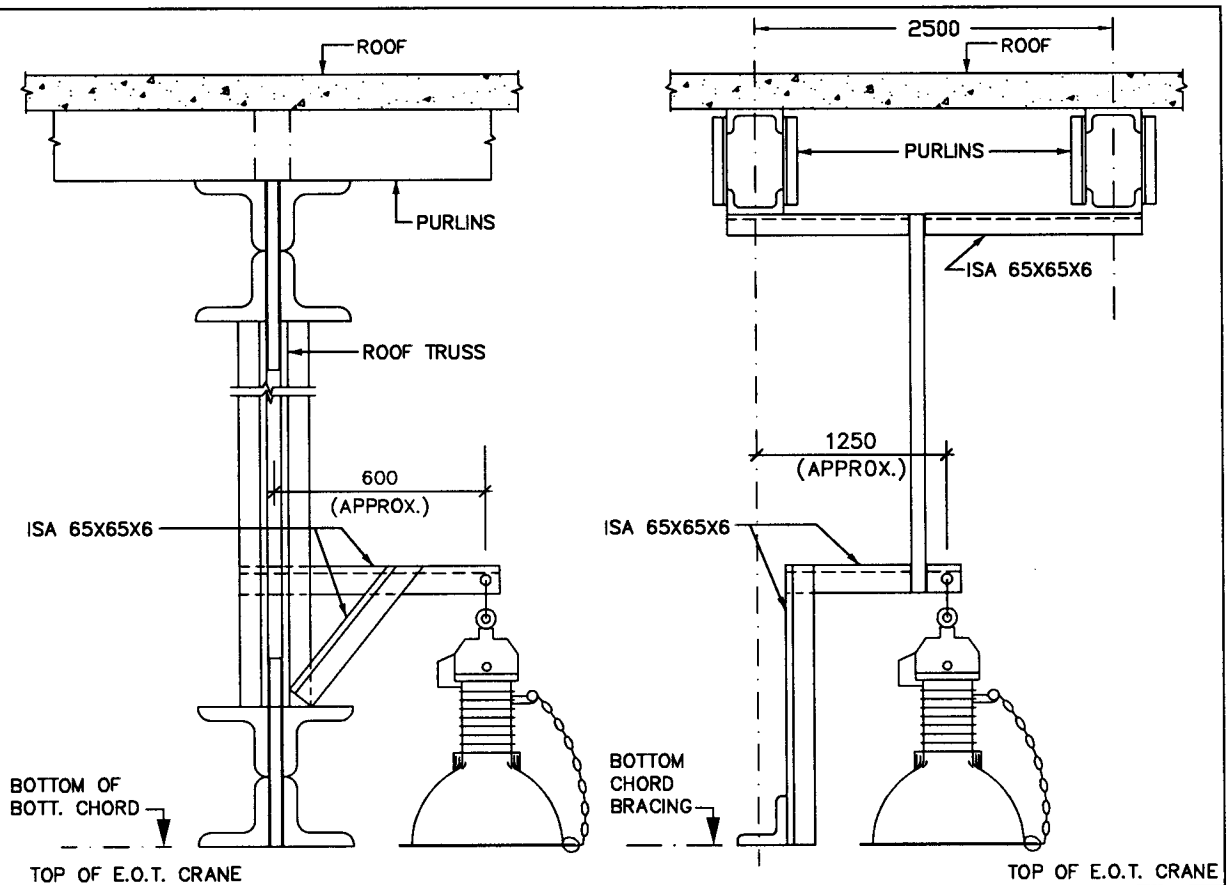
SHT. 19



INDUSTRIAL WELL GLASS CEILING MOUNTED LUMAIRES

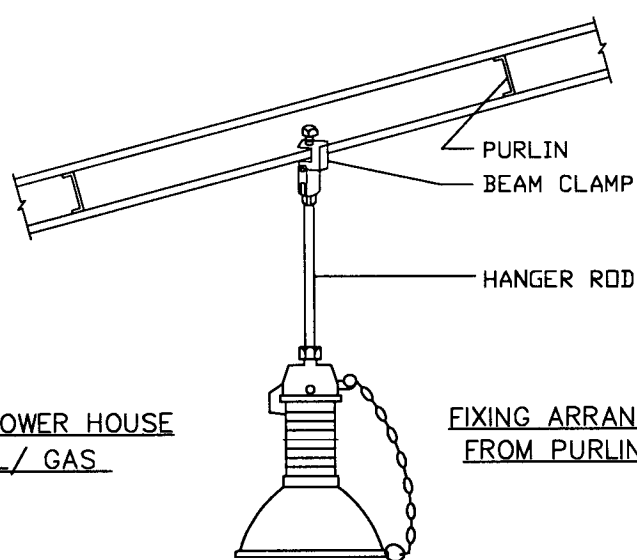
GS ECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		JOB NO. K9213R	SCALE : NIL
SKB	MS	BR	0	02.07.12			DWG. NO. K9213R-DWG-E-0800	REV. 0
APPVD.	REVWD.	CHKO.	REV.	DATE			SHT. 20	



FIXING ARRANGEMENT FROM ROOF TRUSS

FIXING ARRANGEMENT FROM BOTTOM CHORD BRACING



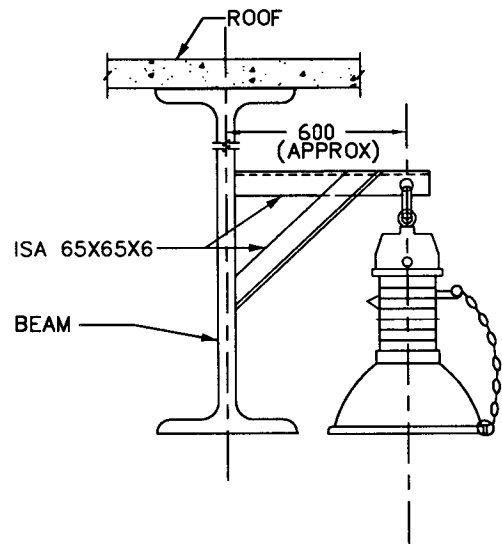
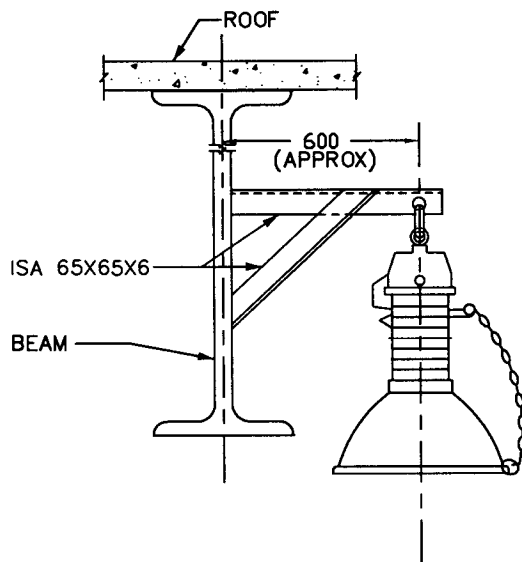
FIXING ARRANGEMENT FROM PURLIN

TYP. FIXING ARRGT. IN POWER HOUSE FROM ROOF OF T.G. HALL/ GAS COMPRESSOR HALL

HIGH PERFORMANCE HIGH BAY AND MEDIUM BAY LUMINAIRE WITH HPSV LAMPS (150 TO 400W), HIGH PRESSURE MERCURY VAPOUR AND METAL HALIDE LAMPS (250 TO 400W).
 [EQ. PHILIPS TYPE HPK 225/HPK 205]
 [EQ. BAJAJ TYPE BGEHB]

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
 VADODARA, GUJARAT

						TITLE: ILLUMINATION SYSTEM NOTES & DETAILS	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
						PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	JOB NO. K9213R DWG. NO. K9213R-DWG-E-0800 SHT. 21	SCALE : NIL REV. 0
SKB	MS	BR	0	02.07.12				
APPVD.	REVWD.	CHKD.	REV.	DATE				



TYPICAL FIXING ARRGT. FROM BEAM

(IN AREA OTHER THAN POWER HOUSE T.G. HALL)

HIGH PERFORMANCE HIGH BAY AND MEDIUM BAY LUMINAIRE
WITH HPSV LAMPS (150 TO 400W), HIGH PRESSURE MERCURY VAPOUR
AND METAL HALIDE LAMPS (250 TO 400W).

[EQ. PHILIPS TYPE HPK 225/HPK-205]

[EQ. BAJAJ TYPE BGEHB]

NOTE:

BOTTOM OF FIXTURE ELEVATION SHALL BE FLUSH WITH OR BELOW BOTTOM
OF BEAM ELEVATION DEPENDING ON THE BOTTOM OF FIXTURE ELEVATION AND
THE ASSOCIATED BEAM SIZE, IN ANY CASE BOTTOM OF FIXTURE ELEVATION
SHALL NOT BE ABOVE THE ASSOCIATED BOTTOM OF BEAM ELEVATION.

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

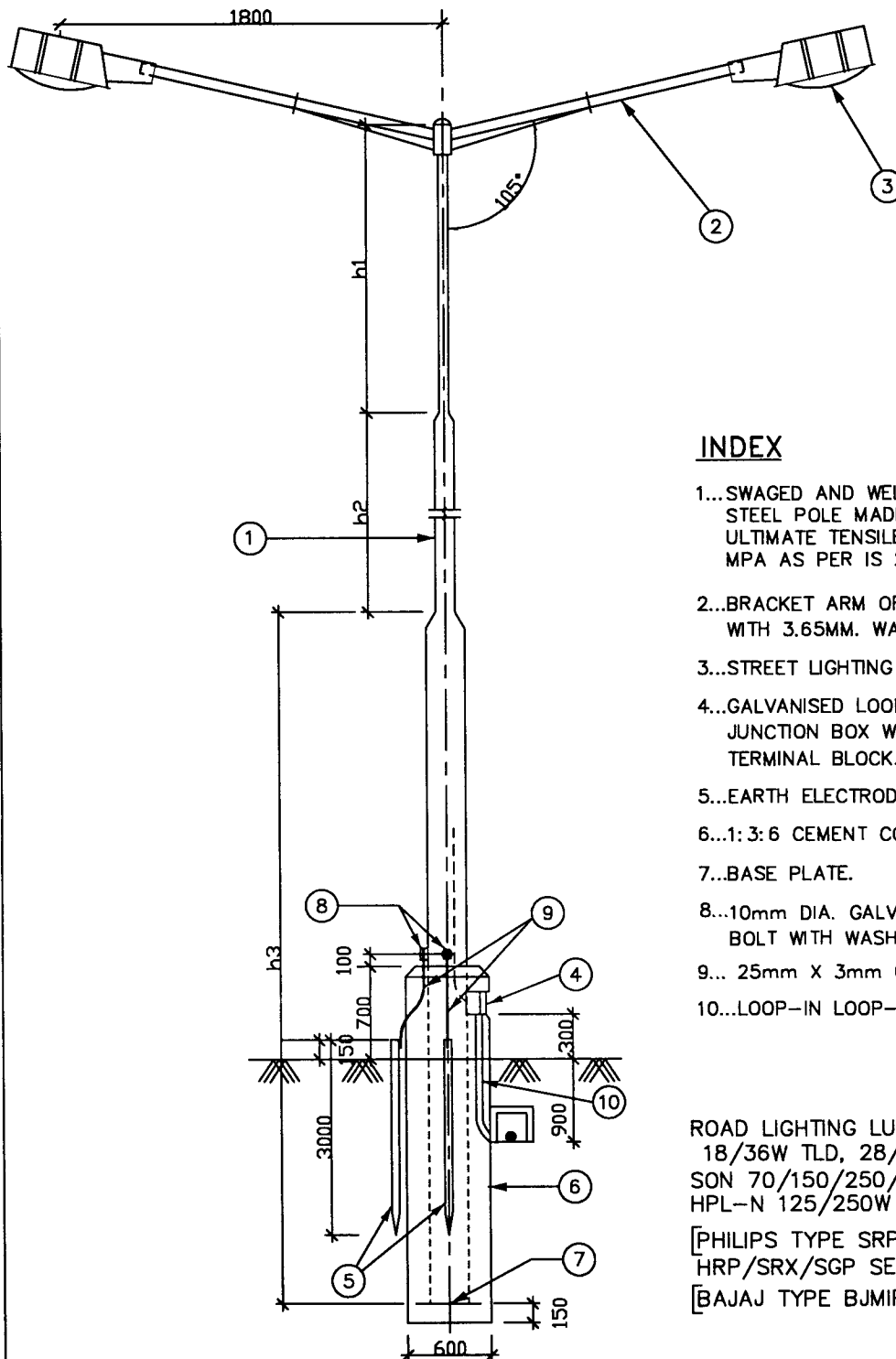
JOB NO. K9213R

SCALE : NIL

DWG. NO. K9213R-DWG-E-0800

REV.
SHT. 22 0

109



INDEX

- 1...SWAGED AND WELDED GALVANISED STEEL POLE MADE FROM STEEL OF ULTIMATE TENSILE STRENGTH 540 MPA AS PER IS 2713 PART-III.
- 2...BRACKET ARM OF 50MM. DIA. PIPE WITH 3.65MM. WALL THICKNESS.
- 3...STREET LIGHTING FIXTURE.
- 4...GALVANISED LOOP-IN LOOP-OUT JUNCTION BOX WITH SP MCB, TERMINAL BLOCK.
- 5...EARTH ELECTRODE.
- 6...1:3:6 CEMENT CONCRETE SQ. FOOTING.
- 7...BASE PLATE.
- 8...10mm DIA. GALVANISED M.S. EARTHING BOLT WITH WASHER.
- 9... 25mm X 3mm G.S. FLAT.
- 10...LOOP-IN LOOP-OUT GI PIPES.

ROAD LIGHTING LUMINAIRE WITH
18/36W TLD, 28/54 TL5,
SON 70/150/250/400W,
HPL-N 125/250W LAMP

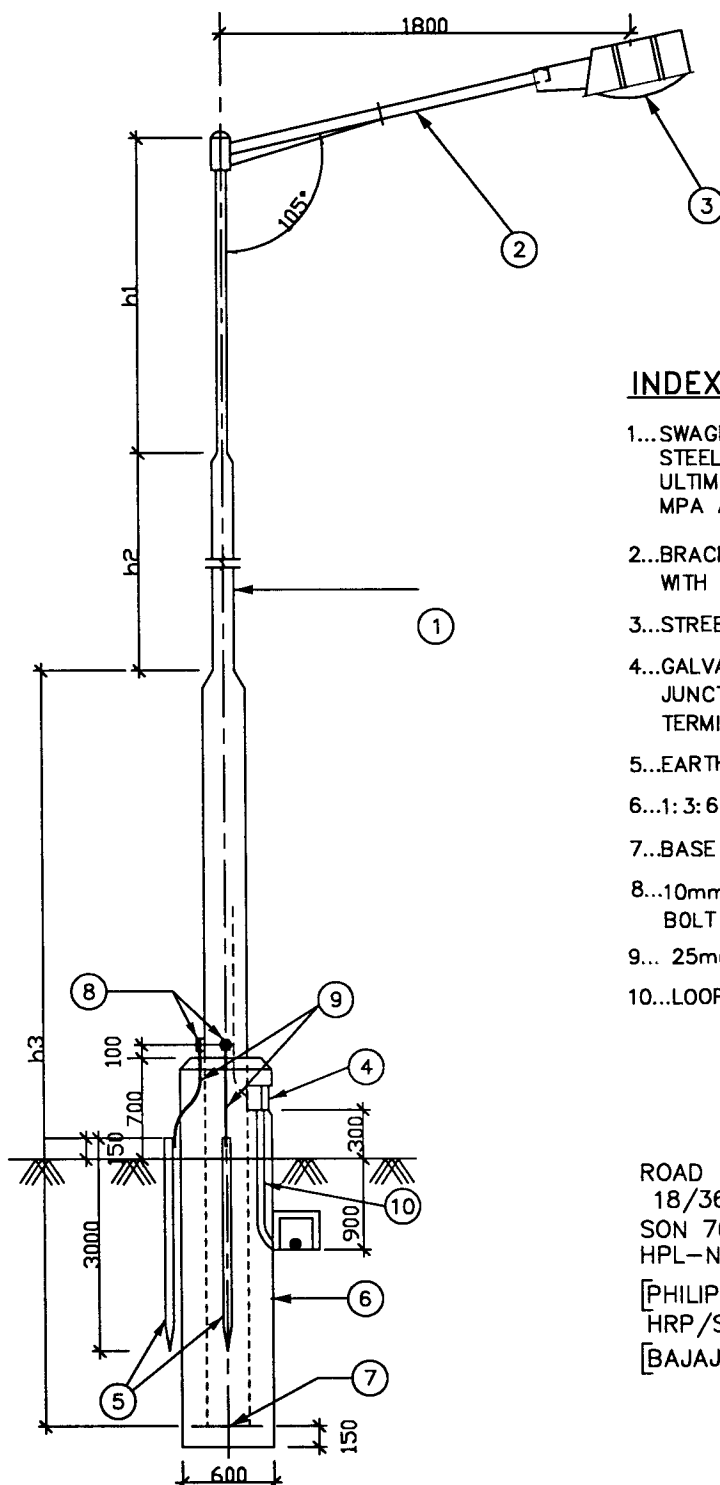
[PHILIPS TYPE SRP/TRC/HGS/
HRP/SRX/SGP SERIES OR EQUAL]
[BAJAJ TYPE BJMIP SERIES OR EQUAL]

SWAGED AND WELDED POLE WITH DOUBLE ARM

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

						TITLE: ILLUMINATION SYSTEM NOTES & DETAILS	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
						PROJECT:	JOB NO. K9213R	SCALE : NIL
SKB	MS	BR	0	02.07.12		1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	DWG. NO. K9213R-DWG-E-0800	REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE			SHT. 23	

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INDEX

- 1...SWAGED AND WELDED GALVANISED STEEL POLE MADE FROM STEEL OF ULTIMATE TENSILE STRENGTH 540 MPA AS PER IS 2713 PART-III.
- 2...BRACKET ARM OF 50MM. DIA. PIPE WITH 3.65MM. WALL THICKNESS.
- 3...STREET LIGHTING FIXTURE.
- 4...GALVANISED LOOP-IN LOOP-OUT JUNCTION BOX WITH SP MCB, TERMINAL BLOCK.
- 5...EARTH ELECTRODE.
- 6...1:3:6 CEMENT CONCRETE SQ. FOOTING.
- 7...BASE PLATE.
- 8...10mm DIA. GALVANISED M.S. EARTHING BOLT WITH WASHER.
- 9... 25mm X 3mm G.S. FLAT.
- 10...LOOP-IN LOOP-OUT GI PIPES.

ROAD LIGHTING LUMINAIRE WITH
18/36W TLD, 28/54 TL5,
SON 70/150/250/400W,
HPL-N 125/250W LAMP

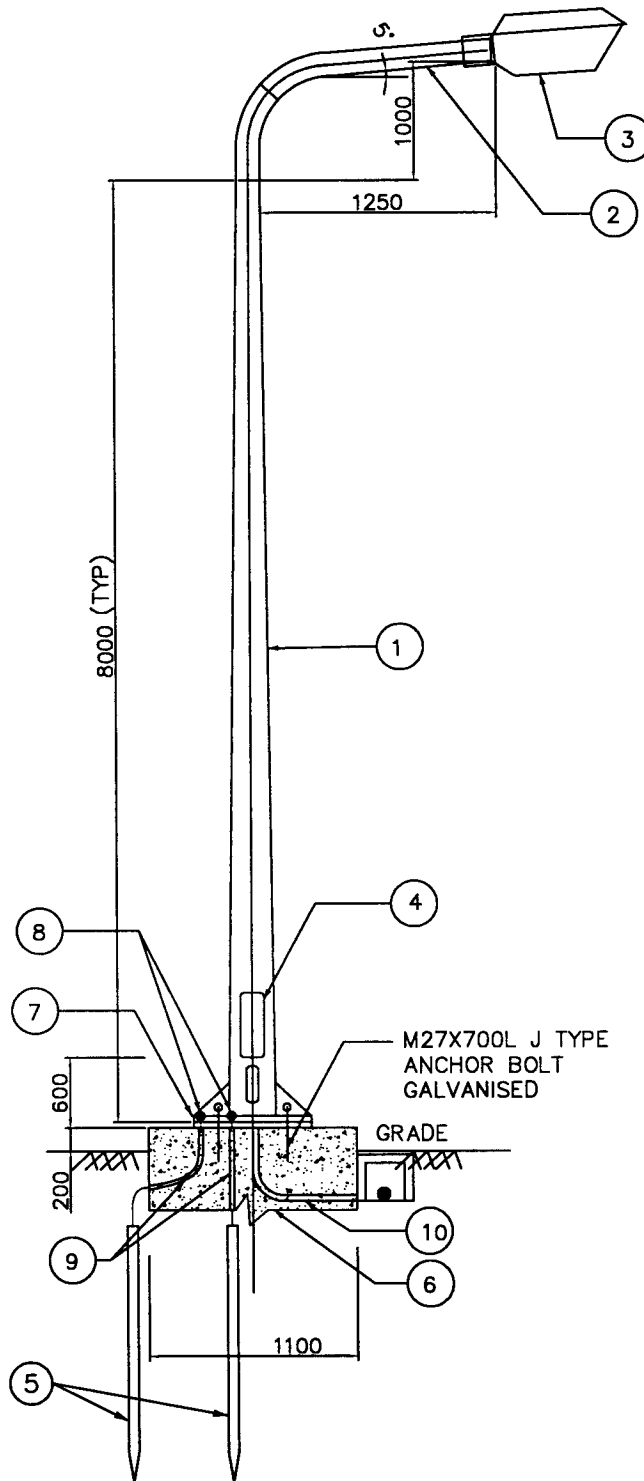
[PHILIPS TYPE SRP/TRC/HGS/
HRP/SRX/SGP SERIES OR EQUAL]
[BAJAJ TYPE BJMIP SERIES OR EQUAL]

SWAGED AND WELDED POLE WITH SINGLE ARM

GS ECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		JOB NO. K9213R	SCALE : NIL
SKB	MS	BR	0	02.07.12			DWG. NO. K9213R-DWG-E-0800	REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE			SHT. 24	

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INDEX

- 1... SINGLE PIECE MS GALVANISED STRUCTURE CONTINUOUSLY TAPERED POLYGONAL CROSS SECTION LIGHT POLE AS PER BS 5649.
- 2... BRACKET ARM OF 50MM. DIA. PIPE WITH 3.65MM. WALL THICKNESS.
- 3... STREET LIGHTING FIXTURE.
- 4... 550 X 200 HINGED DOOR OPENING FOR SP MCB, TERMINAL BLOCK.
- 5... EARTH SPRIKE.
- 6... 1:3:6 CEMENT CONCRETE SQ. FOOTING.
- 7... 450 X 450 BASE PLATE.
- 8... 10mm DIA. GALVANISED M.S. EARTHING BOLT WITH WASHER.
- 9... 8 SWG GI WIRE THROUGH 25mm GI CONDUIT.
- 10... LOOP-IN LOOP-OUT GI PIPES.

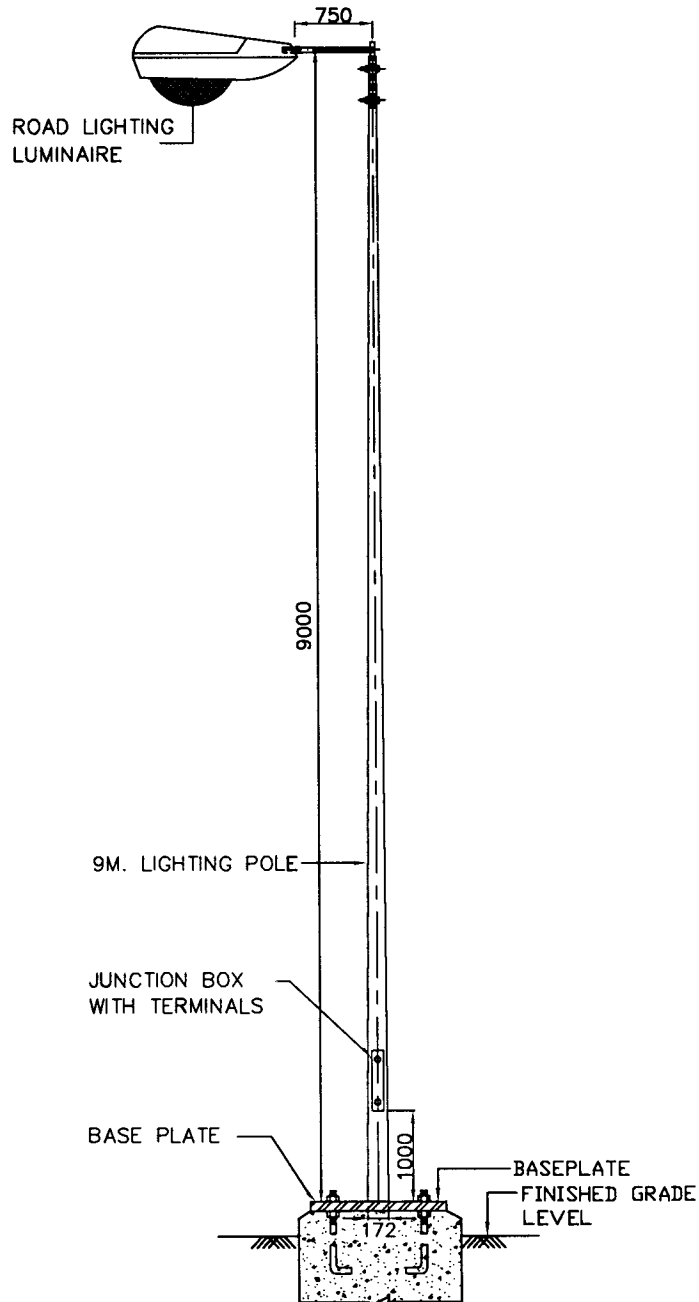
ROAD LIGHTING LUMINAIRE WITH
18/36W TLD, 28/54 TL5,
SON 70/150/250/400W,
HPL-N 125/250W LAMP

[PHILIPS TYPE SRP/TRC/HGS/
HRP/SRX/SGP SERIES OR EQUAL]
[BAJAJ TYPE BJMIP SERIES OR EQUAL]

POLYGONAL SINGLE PIECE POLE

GS ECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODRA, GUJARAT

						TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
						PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	JOB NO. K9213R		SCALE : NIL
SKB	MS	BR	0	04.07.12			DWG. NO. K9213R-DWG-E-0800		REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE			SHT. 25		



ROAD LIGHTING POLE

(POLE GROUNDING ARRANGEMENT SHALL BE IN LINE WITH SHEET NO 23)

ROAD LIGHTING LUMINAIRE WITH 18/36W TLD, 28/54 TL5,
SON 70/150/250/400W, HPL-N 125/250W LAMP
OR CFL 11W/18W/36W..

[PHILIPS TYPE SRP/TRC/HGS/FGS/HRP/FRP/SRX/SGP SERIES OR EQUAL]

[BAJAJ TYPE BJS�A/BJMIP SERIES OR EQUAL]

GSCL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

JOB NO. K9213R

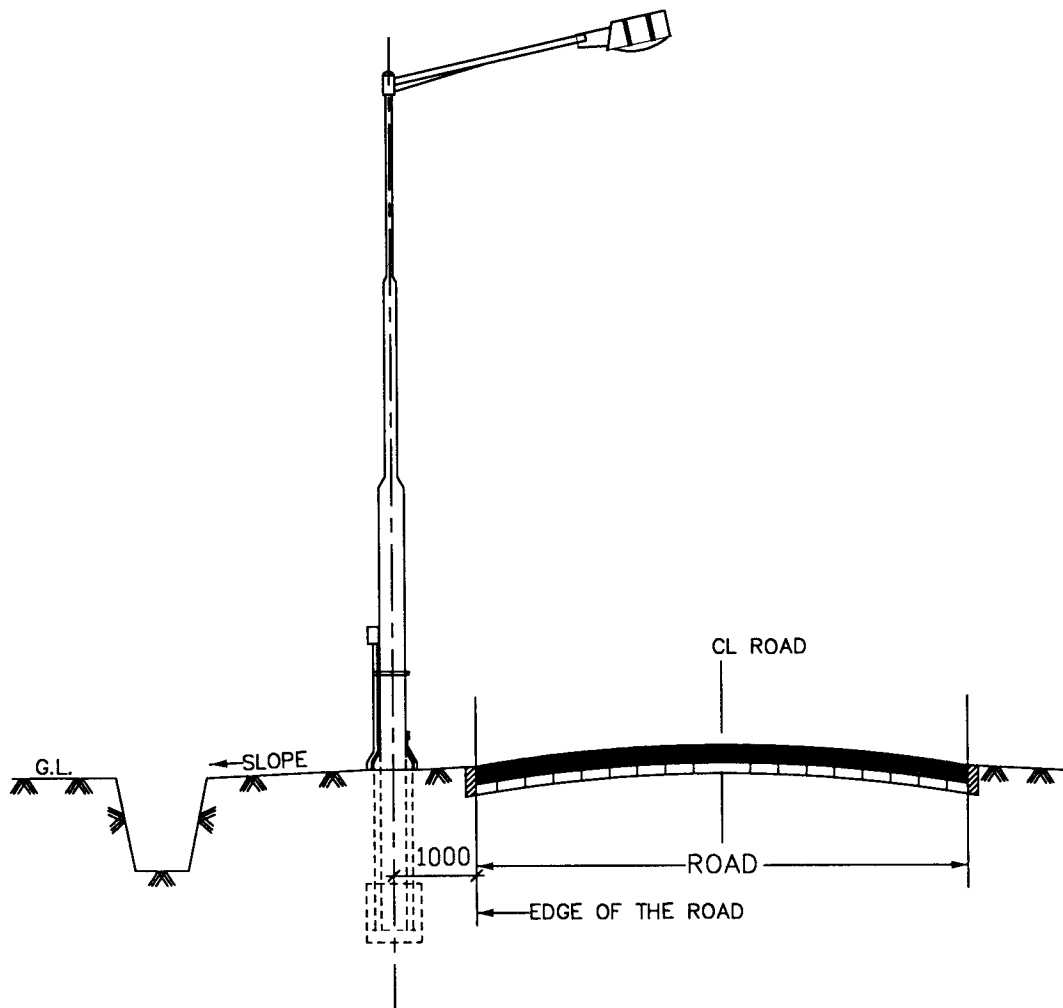
SCALE : NIL

DWG. NO. K9213R-DWG-E-0800

SHT. 26

REV. 0

105



TYPICAL ARRANGEMENT OF ROAD LIGHT POLE

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

JOB NO. K9213R

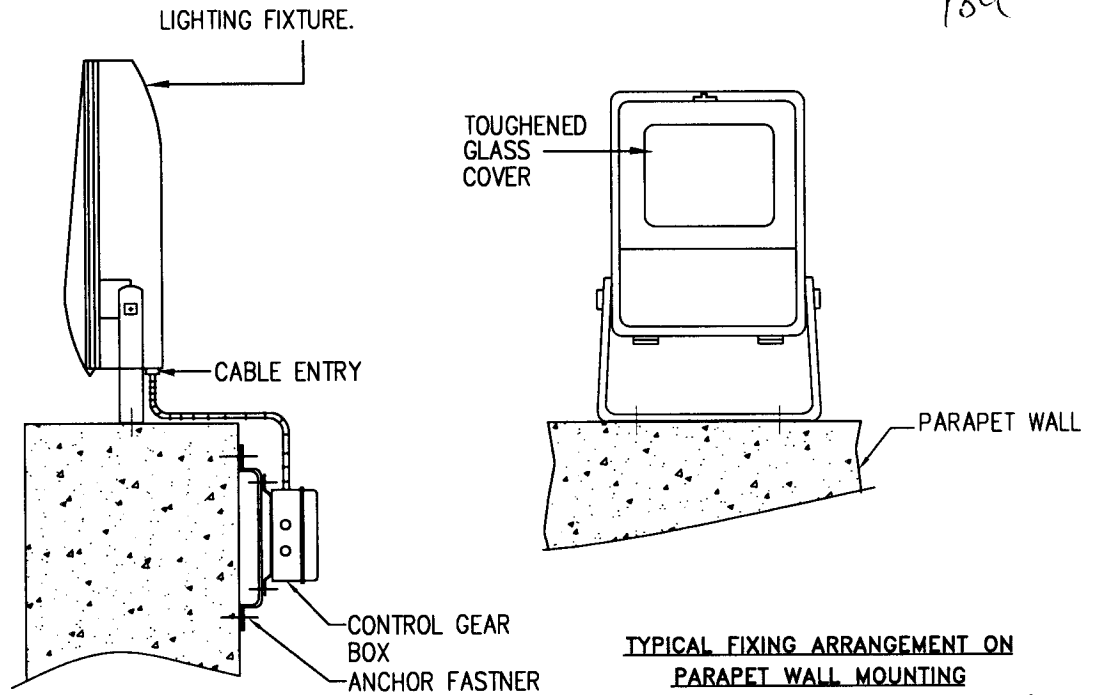
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DWG. NO. K9213R-DWG-E-0800

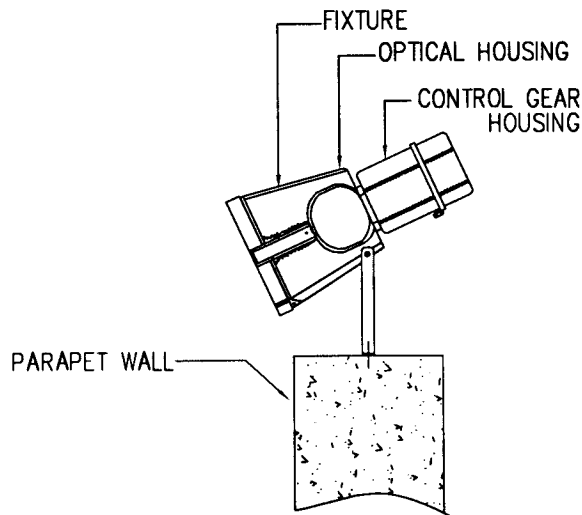
SHT. 27

REV.
0

104



**TYPICAL FIXING ARRANGEMENT ON
PARAPET WALL MOUNTING
(NON-INTEGRAL FLOOD LIGHT LUMINAIRE)**



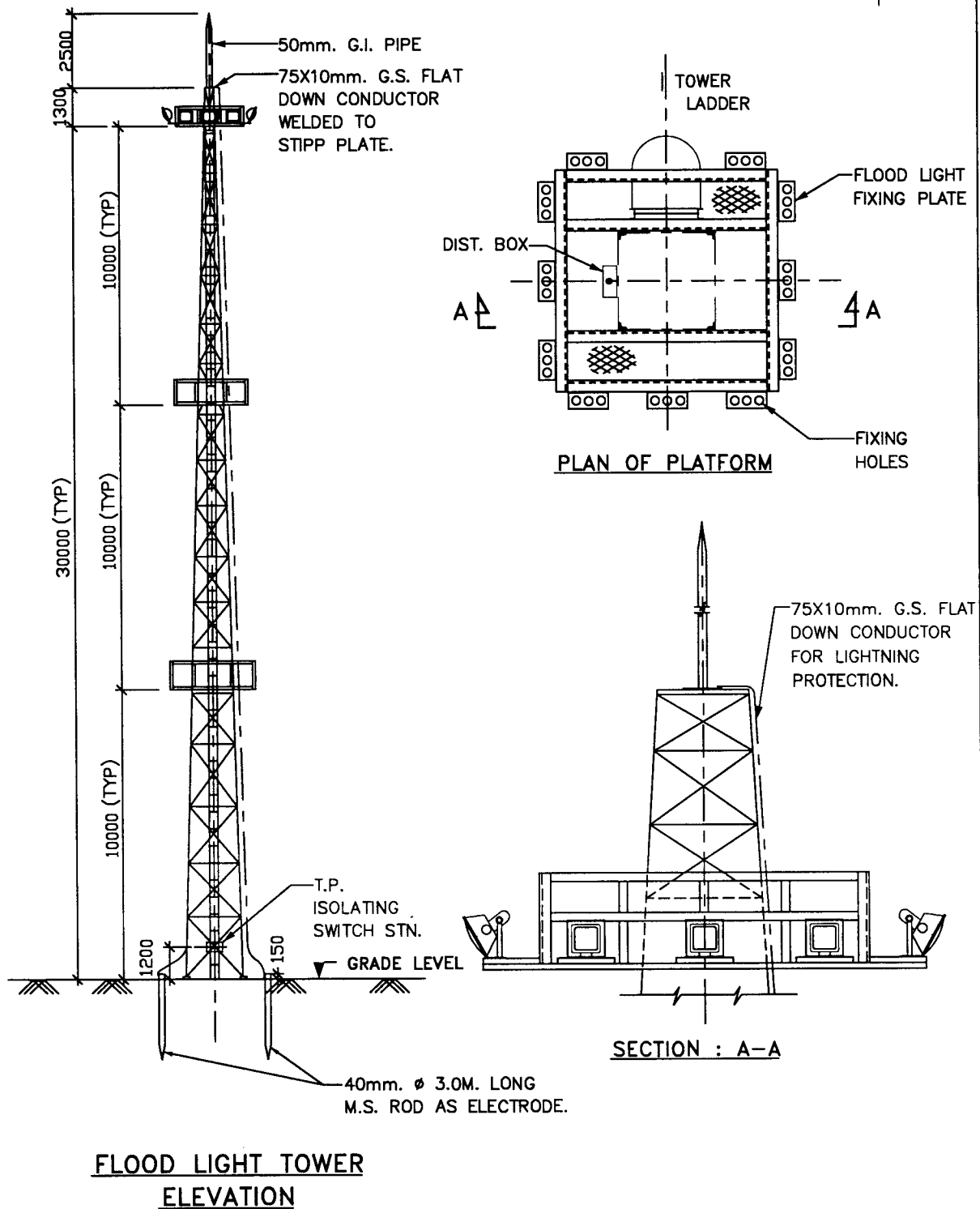
**TYPICAL FIXING ARRANGEMENT ON
PARAPET WALL MOUNTING
(INTEGRAL FLOOD LIGHT LUMINAIRE)**

FLOOD LIGHT LUMINAIRE WITH HPSV 150/250W/400W/1000W
OR HIGH PRESSURE METAL HALIDE 250W/400W/1000W,
OR TUNGSTEN HALOGEN 500W/1000W LAMP.
[EQ. PHILIPS TYPE SWF/MWF/SNF/SLF/RVP]
[EQ. BAJAJ TYPE BJQF/BJHF/BJEQF/BJEF/BJENF/BJHM/BGEMF/BGEMFS]

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		JOB NO. K9213R		SCALE : NIL	
					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		DWG. NO. K9213R-DWG-E-0800		REV. 0	
SKB	MS	BR	0	02.07.12					SHT. 28	
APPVD.	REVWD.	CHKD.	REV.	DATE						

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NOTE :

Anticlimbing features shall be provided with the stair up to 1500mm above ground level.

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE:
ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

JOB NO. K9213R

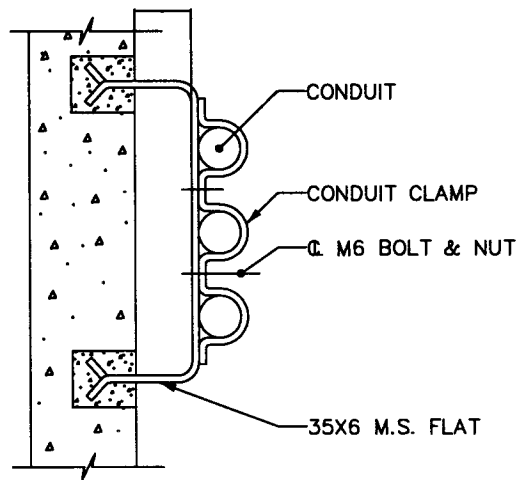
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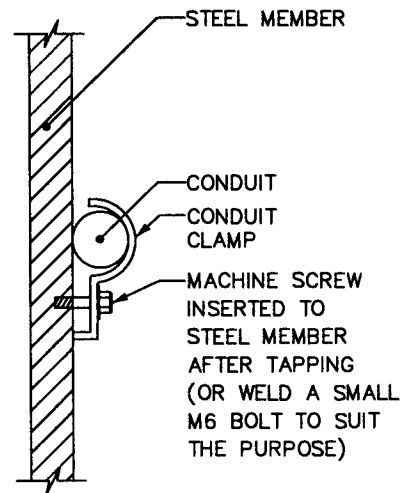
SHT. 30

REV.
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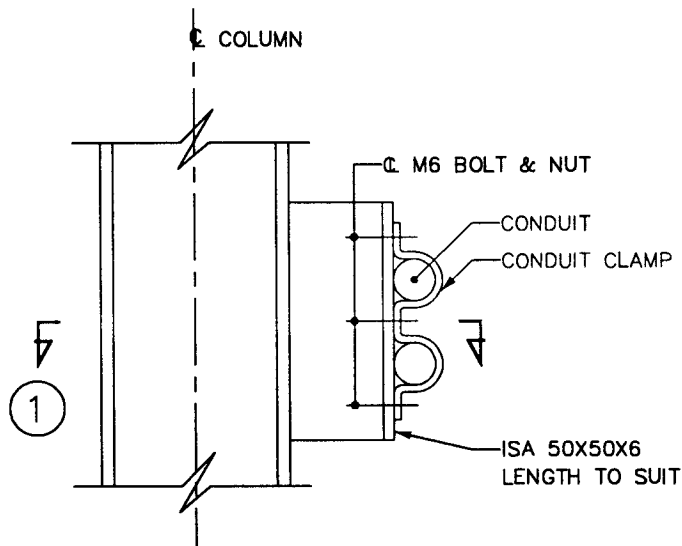
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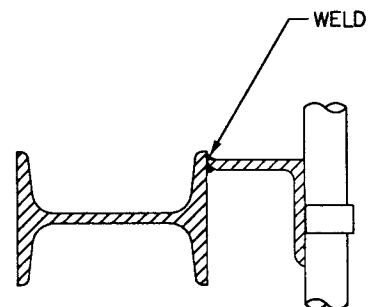
GROUP OF CONDUITS RUN ON CONCRETE SURFACE



SINGLE CONDUIT RUN ON STEEL MEMBER



ELEVATION



SECTION-1

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT-A

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODRA, GUJARAT

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

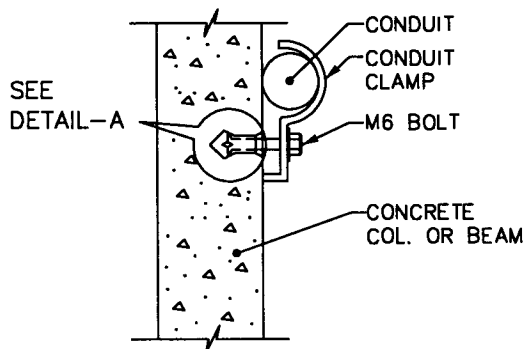
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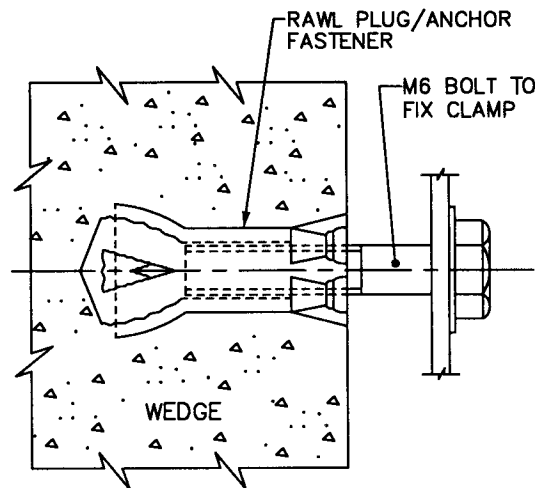
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SHT. 31

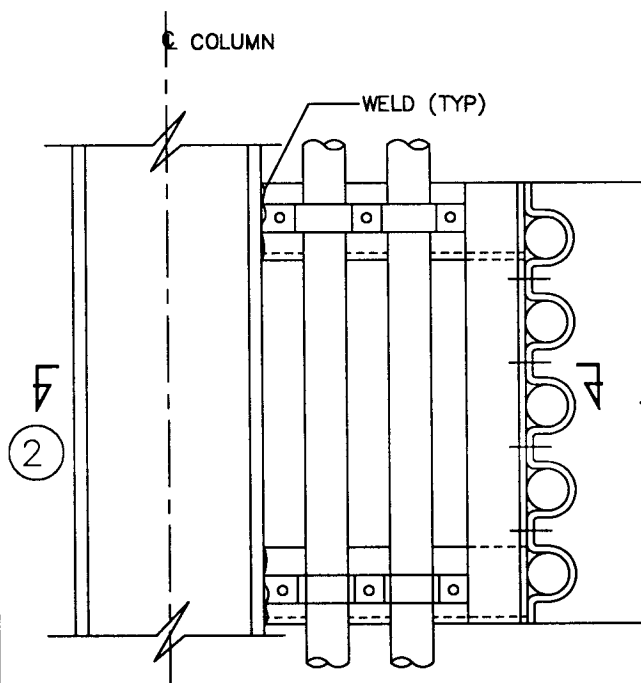
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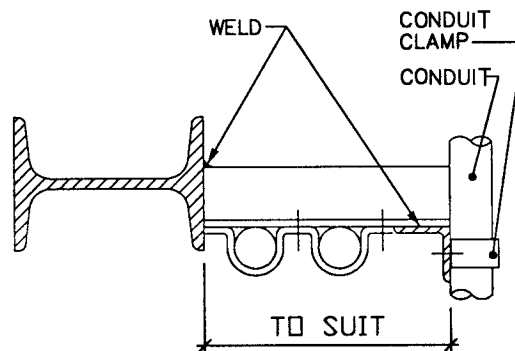
SINGLE CONDUIT RUN
ON CONCRETE SURFACE



DETAIL-A



ELEVATION



SECTION-2

GROUP OF CONDUIT RUN ON
STEEL MEMBER ARRANGEMENT-B

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODRA, GUJARAT



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CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

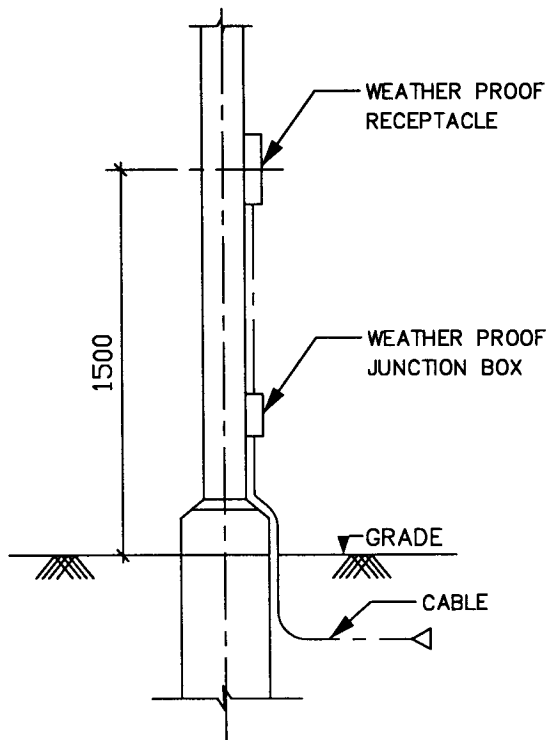
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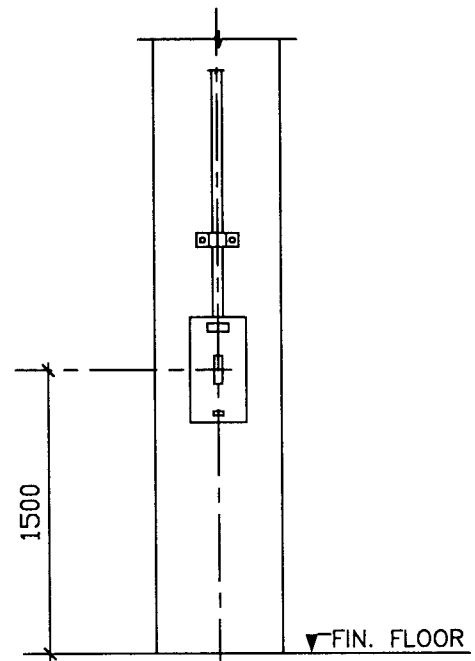
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SHT. 32

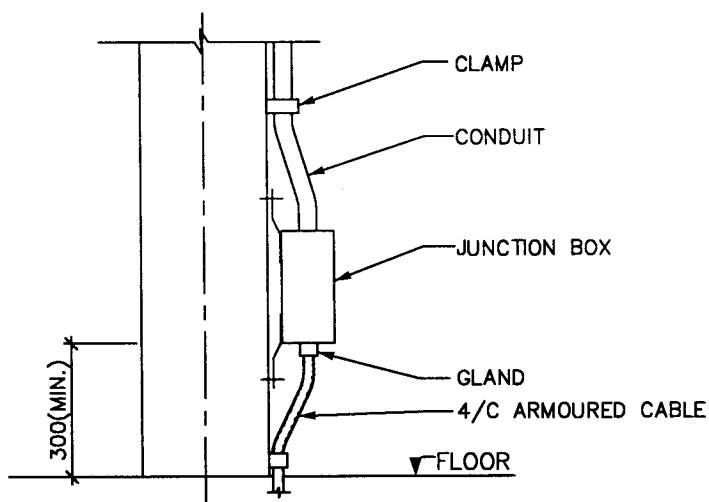
REV.
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OUTDOOR RECEPTACLE



SWITCH ON COLUMN

JUNCTION BOX
MOUNTING (TYP.)

GS ECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #6 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

JOB NO. K9213R

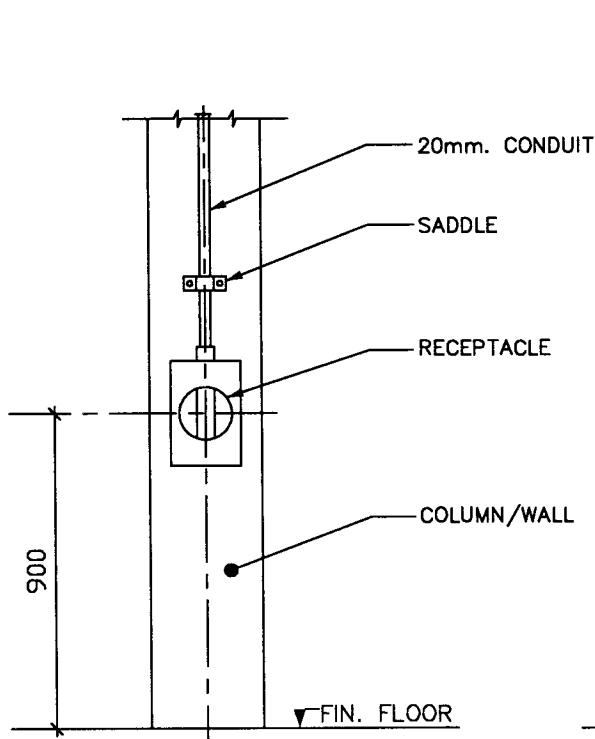
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DWG. NO. K9213R-DWG-E-0800

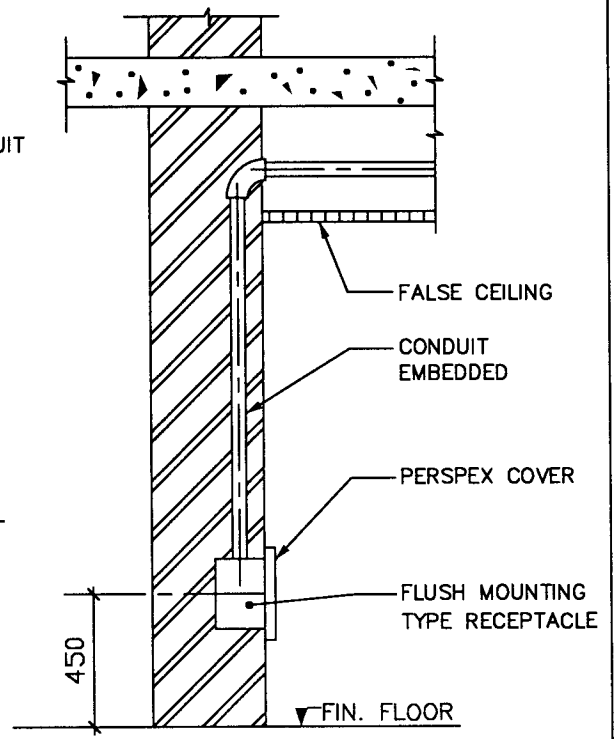
REV.

SHT. 33

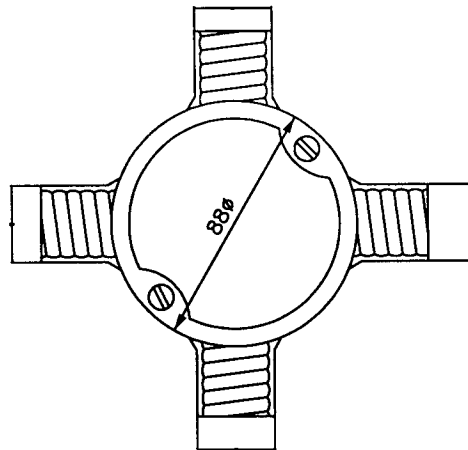
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RECEPTACLE - TYPE 'RB'
(STRUCTURE MOUNTING)



RECEPTACLE - TYPE 'RA'
(WALL MOUNTING)



JUNCTION BOX ROUND (TYP.)

GSCL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

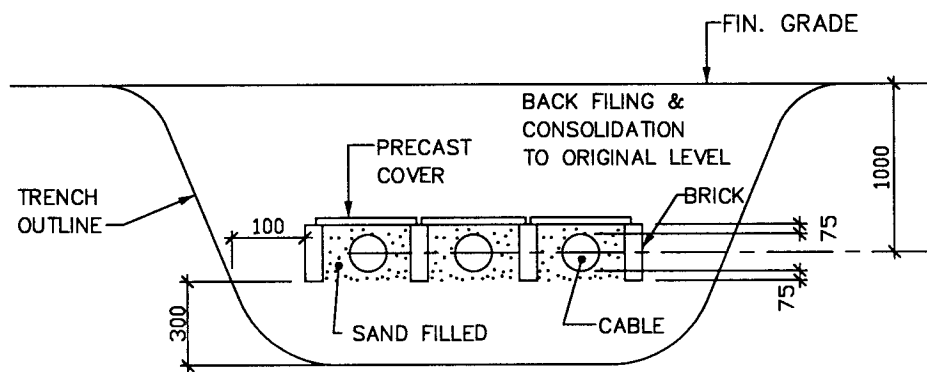
SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

JOB NO. K9213R	SCALE : NIL
DWG. NO. K9213R-DWG-E-0800	REV. 0
SHT. 34	

97



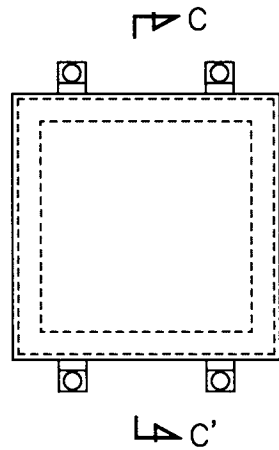
TYP. DETAIL FOR BURIED CABLE

A4_DD (9-96) [210x297]

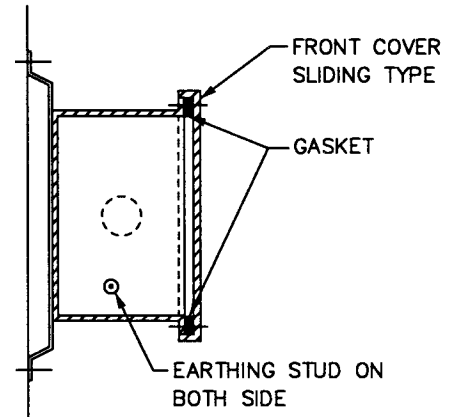


					 GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
					 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					JOB NO. K9213R	SCALE : NIL
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)					DWG. NO. K9213R-DWG-E-0800	REV. 0
SKB	MS	BR	0	02.07.12	SHT. 35	
APPVD.	REVWD.	CHKD.	REV.	DATE		

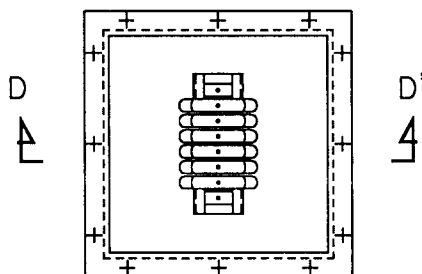
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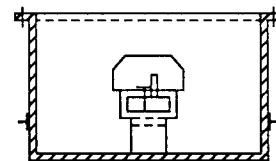
TYP. FIXING DETAIL
OF JUNCTION BOX



SECTION : C-C'



JUNCTION BOX (TYP.)
FRONT VIEW



SECTION : D-D'

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA . MUMBAI . CHENNAI . NEW DELHI

SKB	MS	BR	0	02.07.12
APPVD.	REVWD.	CHKD.	REV.	DATE

TITLE: ILLUMINATION SYSTEM
NOTES & DETAILS

PROJECT:
1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT JB AT WANAKBORI THERMAL POWER STATION, GUJARAT)

JOB NO. K9213R

SCALE : NIL

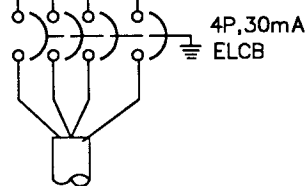
DWG. NO. K9213R-DWG-E-D800

SHT. 36

REV. 0

95

LOCATION	NO.& TYPE OF FIXTURE	LOAD (WATT)	CKT. NO.	SP MCB (TYP)	R	Y	B	N	CKT. NO.	LOAD (WATT)	NO.& TYPE OF FIXTURE	LOCATION
			1						10			
			2						11			
			3						12			
			4						13			
			5						14			
			6						15			
			7						16			
			8						17			
			9						18			



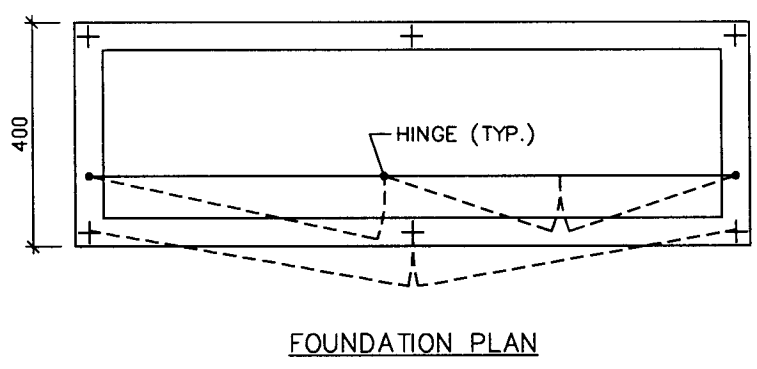
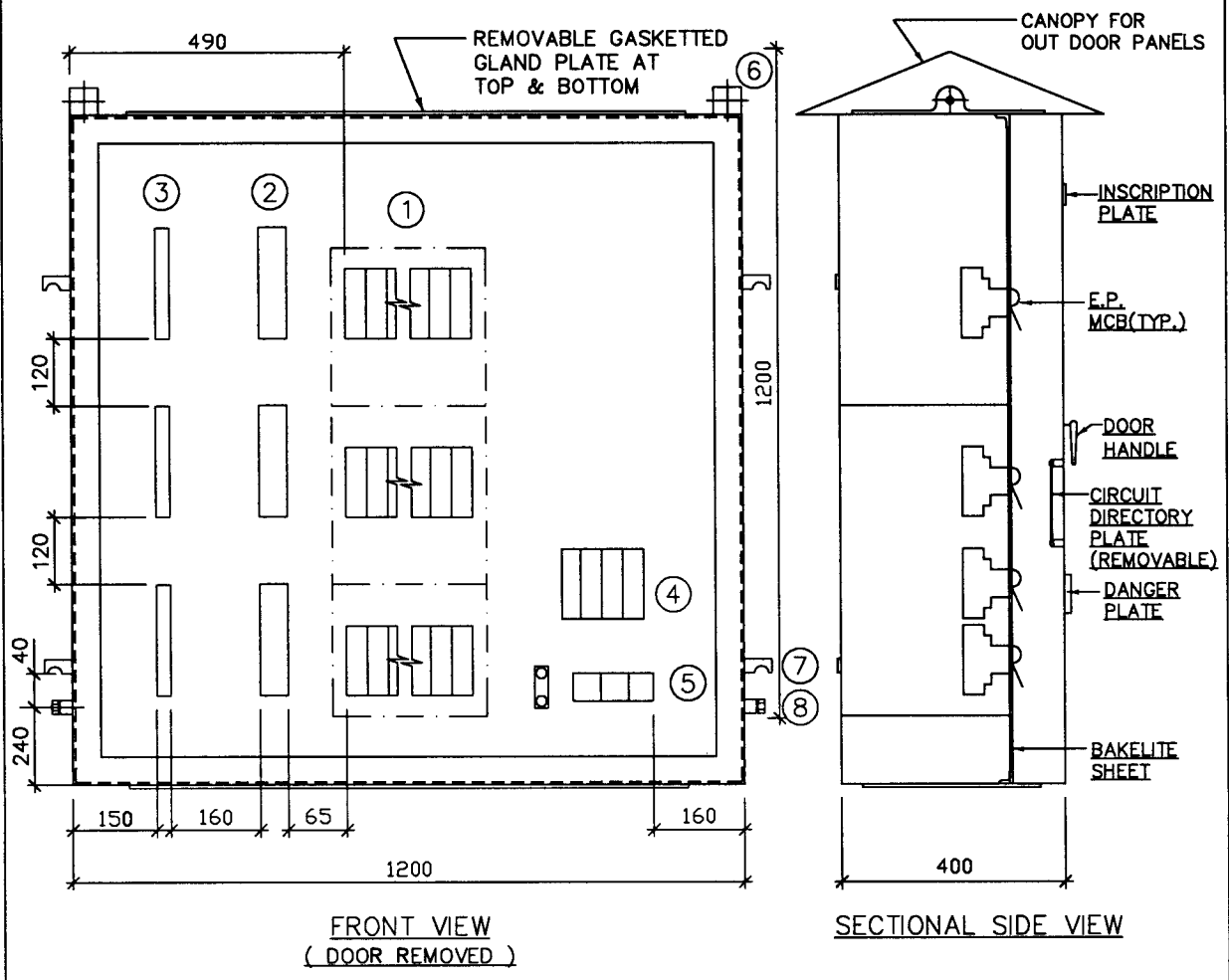
3-LINE DIAGRAM : LIGHTING PANEL

NOTES:

1. THE NUMBER OF OUTGOING FEEDERS SHALL BE DECIDED BASED ON REQUIREMENT.
2. THE MCB AND ELCB RATING SHALL BE SELECTED BASED ON APPLICATION.

					GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
					DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT JB AT WANAKBORI THERMAL POWER STATION, GUJARAT)	
SKB	MS	BR	0	02.07.12	JOB NO.	K9213R
APPVD.	REVWD.	CHKD.	REV.	DATE	DWG. NO.	K9213R-DWG-E-0800
					SCALE :	NIL
					SHT. 37	REV. 0

44

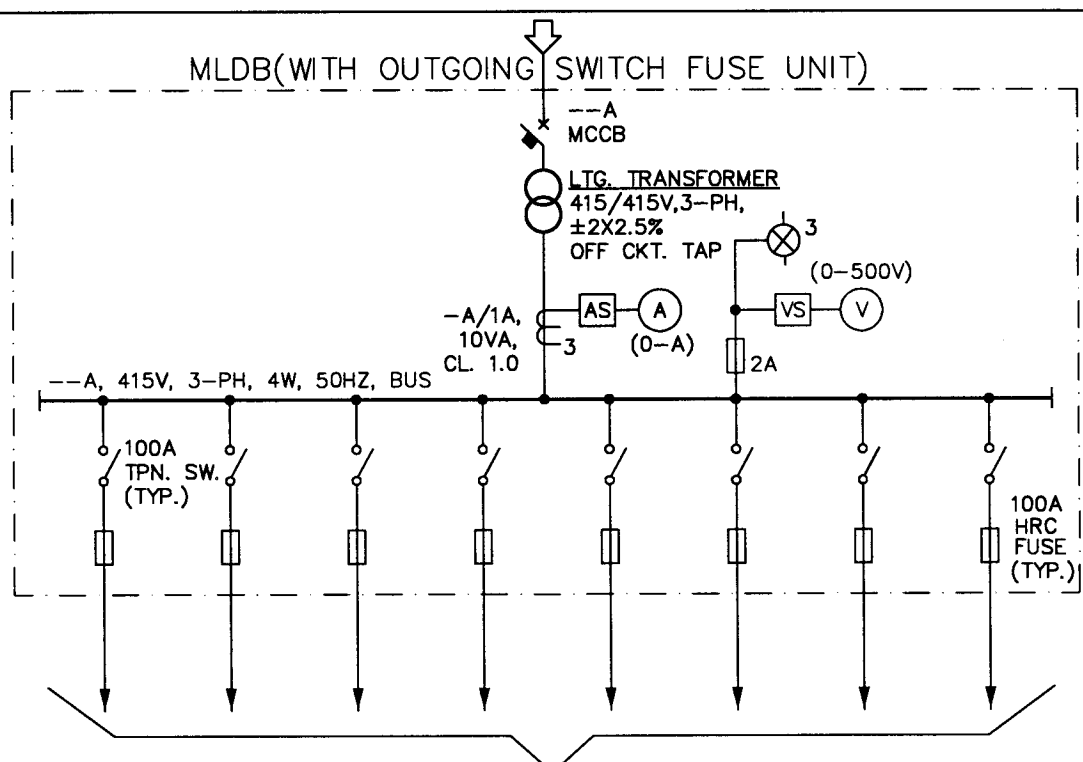


LEGEND :

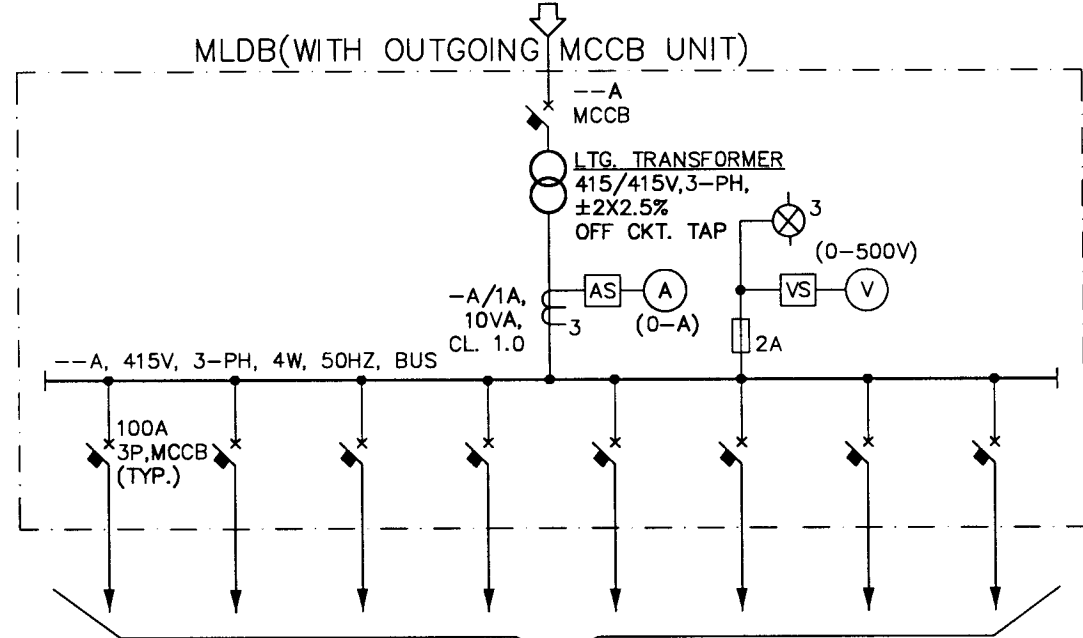
- ① MINIATURE CKT. BKR.
- ② PHASE TERMINALS STRIP
- ③ NEUTRAL BUS WITH NUT, BOLT & WASHER
- ④ ELCB
- ⑤ TERMINAL BLOCK
- ⑥ LIFTING LUG
- ⑦ FIXING LUG
- ⑧ EARTHING STUD WITH NUTS

GENERAL ARRANGEMENT : LIGHTING PANEL

					 GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODRA, GUJARAT	
					 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT MANAKBORI THERMAL POWER STATION, GUJARAT)	
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT MANAKBORI THERMAL POWER STATION, GUJARAT)					JOB NO. K9213R SCALE : NIL	
APPVD. SKB REVWD. MS CHKD. BR REV. 0 DATE 02.07.12					DWG. NO. K9213R-DWG-E-0800 REV. 0	
					SHT. 38	



TO LIGHTING PANELS



TO LIGHTING PANELS

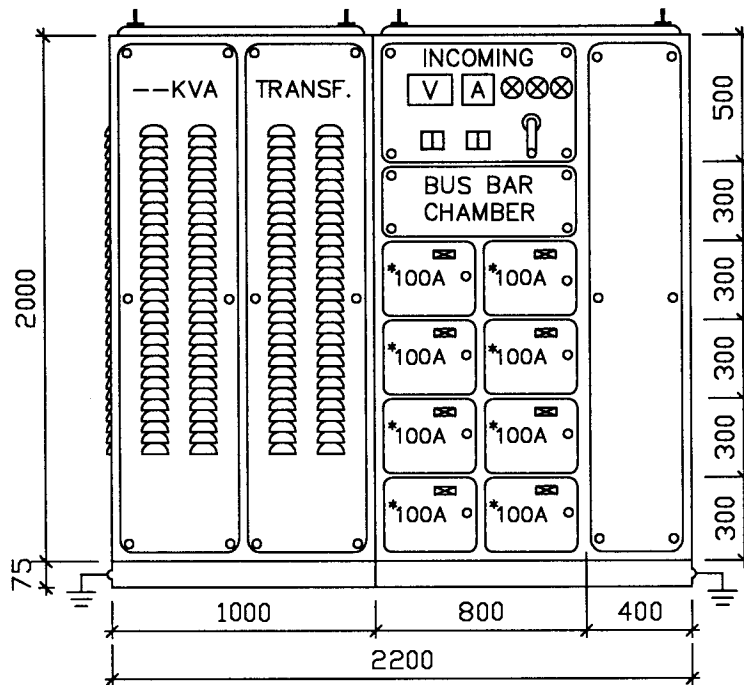
SLD : MAIN LIGHTING DISTRIBUTION BOARD(MLDB)

NOTE :-

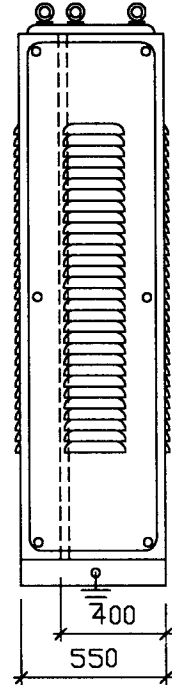
TRANSFORMER RATING AND %Z SHALL BE SO SELECTED THAT THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB OF LIGHTING PANELS. THE BUSBAR CONTINUOUS CURRENT RATING, CT RATIO, AMMETER RANGE ETC SHALL BE SELECTED ACCORDINGLY

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					DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					JOB NO. K9213R	SCALE : NIL
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #6 AT WANAKBORI THERMAL POWER STATION, GUJARAT)					DWG. NO. K9213R-DWG-E-0800	REV. 0
SKB	MS	BR	0	02.07.12	SHT. 39	
APPVD.	REVWD.	CHKD.	REV.	DATE		

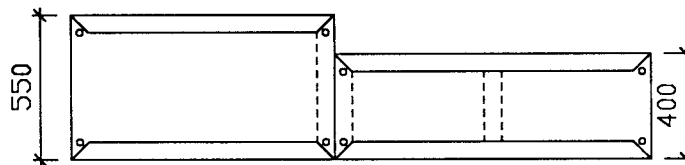
92



FRONT VIEW



SIDE VIEW

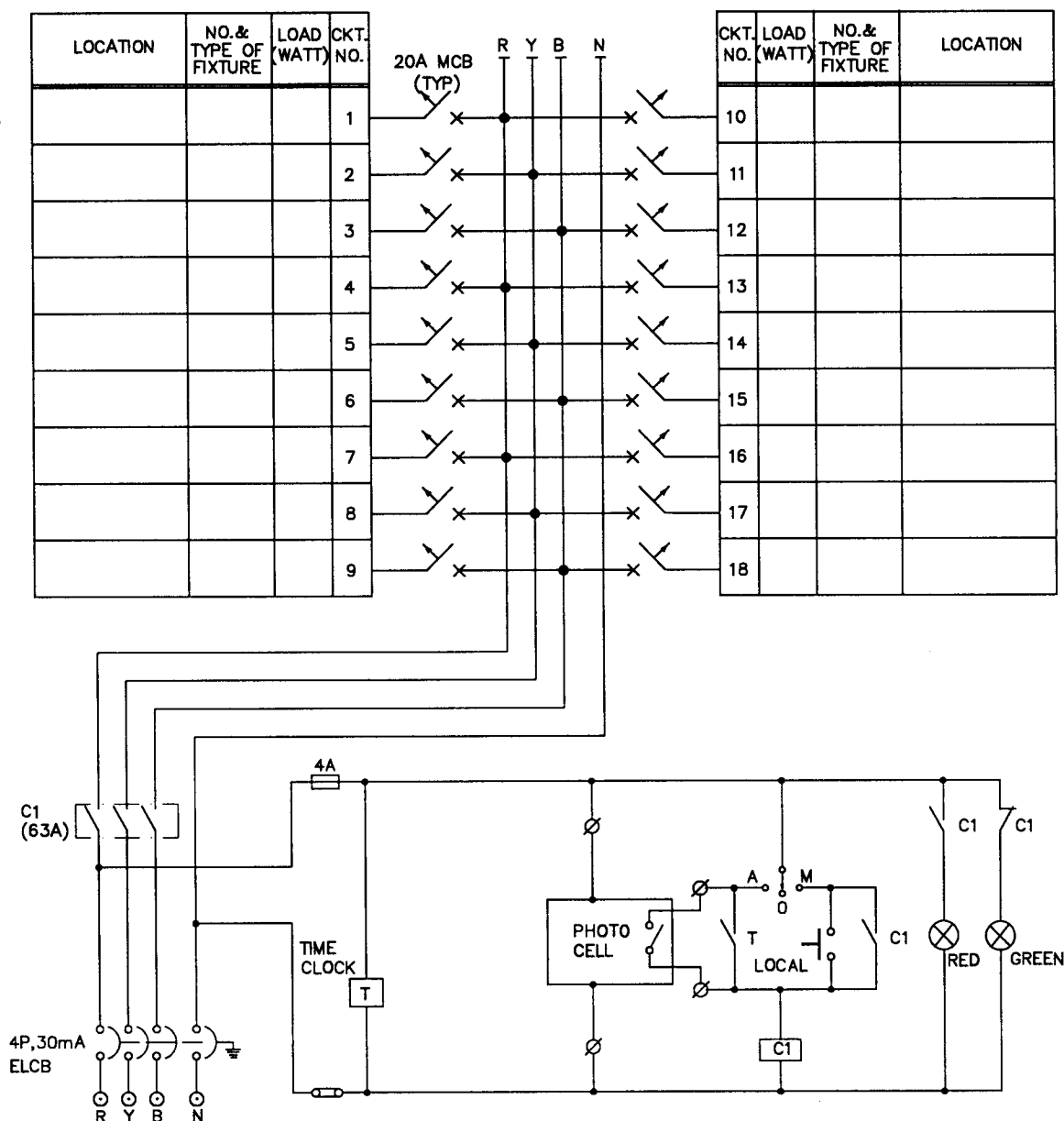


FOUNDATION PLAN

* TPN SWITCH FUSE/TP MCCB.

GENERAL ARRANGEMENT : MAIN LIGHTING DISTRIBUTION BOARD (MLDB)

					 GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
					 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					PROJECT: 1x800 MW SUPERCritical THERMAL POWER PLANT (UNIT JB AT WANAKBORI THERMAL POWER STATION, GUJARAT)	
JOB NO. K9213R					SCALE : NIL	
DWG. NO. K9213R-DWG-E-0800					REV. 0	
SHT. 40						
SKB	MS	BR	0	02.07.12		
APPVD.	REVWD.	CHKD.	REV.	DATE		



NOTES :

1. FIXTURES ON STREET LIGHTING POLES SHALL BE FED FROM THE SLPs.
2. FIXTURES ON FLOOD LIGHTING TOWERS SHALL ALSO BE FED FROM THE SLPs VIA ISOLATING SWITCH IN FLP MOUNTED AT THE BASE OF FLOOD LIGHTING TOWER.
3. SP AND 3P MCB SHALL BE USED FOR SINGLE PHASE AND 3-PHASE DISTRIBUTION RESPECTIVELY.

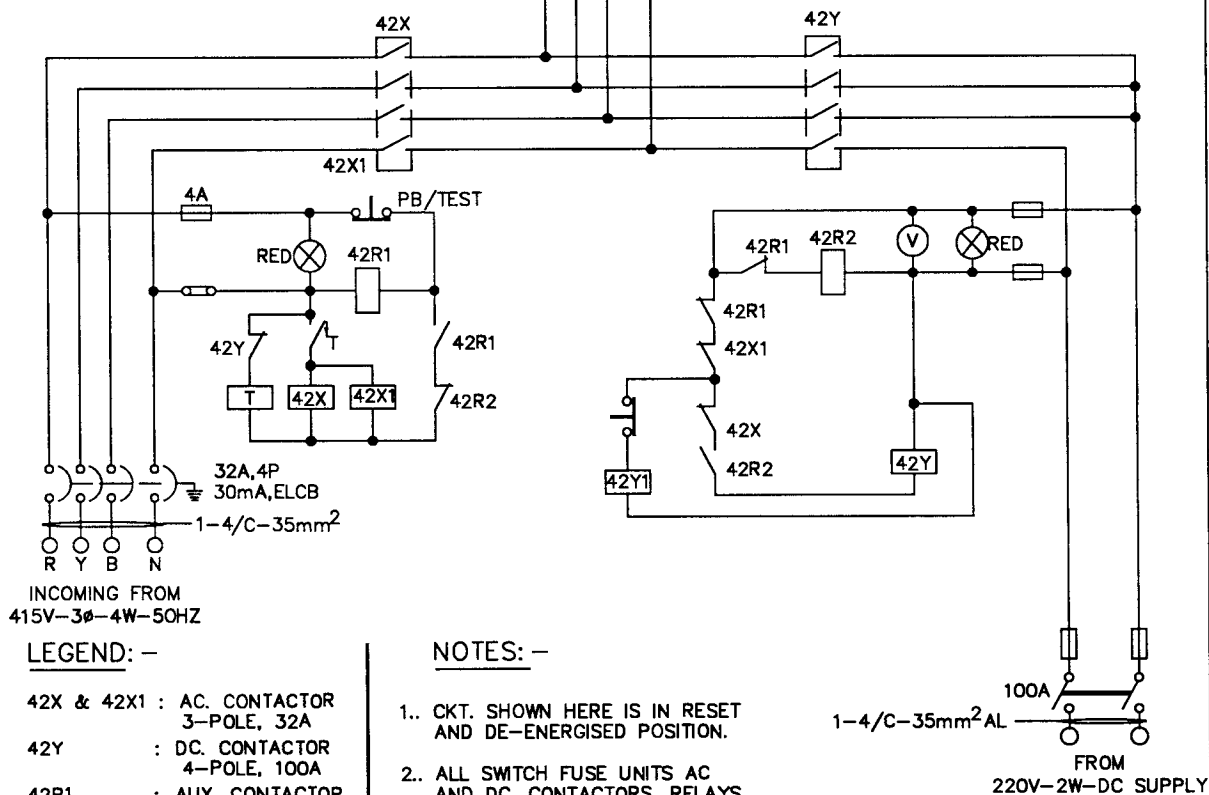
SCHEMATIC : STREET LIGHT PANELS (SLP)

					GSCL GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT	
					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS	 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI
SKB	MS	BR	0	02.07.12	PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	JOB NO. K9213R DWG. NO. K9213R-DWG-E-0800
APPVD.	REVWD.	CHKD.	REV.	DATE		SCALE : NIL SHT. 41 REV. 0

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415V-3 ϕ -4W-50HZ BUS
220V-2W-DC BUS

LOCATION	NO. & TYPE OF FIXTURE	LOAD (WATT)	CKT. NO.	20A, DP MCB (TYP)	R	Y	B	N	CKT. NO.	LOAD (WATT)	NO. & TYPE OF FIXTURE	LOCATION
			1						2			
			3						4			
			5						6			
			7						8			
			9						10			
			11						12			

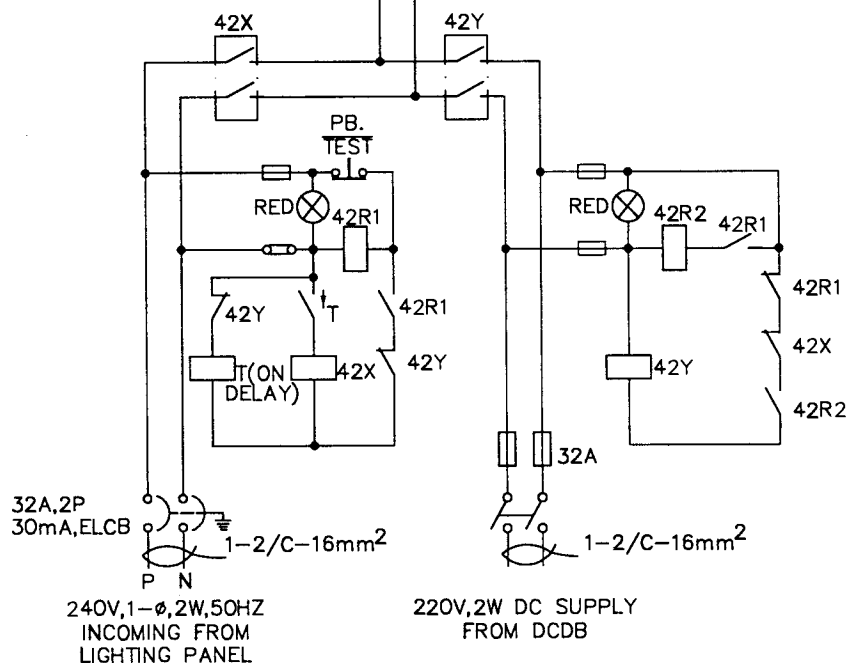


SCHEMATIC : EMERGENCY LTG. DIST. BOARD (3 ϕ)

					GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT		
					DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI		
TITLE: ILLUMINATION SYSTEM NOTES & DETAILS					JOB NO. K9213R		SCALE : NIL
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT J8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)					DWG. NO. K9213R-DWG-E-0800		REV. 0
SKB	MS	BR	0	02.07.12	APPVD. REVWD. CHKD. REV. DATE		SHT. 42

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LOCATION	NO. & TYPE OF FIXTURE	LOAD (WATT)	CKT. NO.	220V, 1- ϕ , 2W, 50HZ BUS 220V, 2W, DC BUS 20A, DP P MCB (TYP)	CKT. NO.	LOAD (WATT)	NO. & TYPE OF FIXTURE	LOCATION
			1		3			
			2		4			



LEGEND :-

42X : AC CONTACTOR, 2-POLE, 32A
 42Y : DC CONTACTOR, 2-POLE, 32A
 42R1: AUX. CONTACTOR 240V AC.
 42R2: AUX. CONTACTOR 220V DC.
 T : TIMER

NOTES :-

1. CKT. SHOWN HERE IS IN RESET AND DE-ENERGISED POSITION.
2. ALL SWITCH FUSE UNITS, AC AND DC CONTACTORS, RELAYS, LAMPS, METERS SHOWN IN THIS DRG. SHALL BE FURNISHED WITH EMERGENCY LTG. BOARD.
3. THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB.

SCHEMATIC : EMERGENCY LTG. DIST. BOARD (1 ϕ)

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
 VADODARA, GUJARAT

					TITLE: ILLUMINATION SYSTEM NOTES & DETAILS		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
					PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)		JOB NO. K9213A	
							SCALE : NIL	
SKB	MS	BR	0	02.07.12			DWG. NO. K9213A-DWG-E-0800	
APPVD.	REVWD.	CHKD.	REV.	DATE			SHT. 43	
							REV. 0	

ANNEXURE-E

**TECHNICAL SPECIFICATION
FOR
ELECTRICAL INSTALLATION**

**TECHNICAL SPECIFICATION
FOR
ELECTRICAL INSTALLATION**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	INTENT OF SPECIFICATION
2.00.00	SCOPE OF WORK
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS - SUPPLY
5.00.00	INSTALLATION - GENERAL
6.00.00	INSTALLATION - CABLING AND GROUNDING
7.00.00	TESTS

**TECHNICAL SPECIFICATION
FOR
ELECTRICAL INSTALLATION**

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification is intended to cover complete and efficient erection, testing and commissioning and putting into successful commercial operation of all electrical equipment specified hereinafter inclusive of supply of all labour, supervision tools, implements & materials as necessary.

1.02.00 The scope of work shall also include the design, manufacture, assembly, testing at manufacturer's works, supply & delivery of conductors, post insulators, string insulators etc. complete with all materials and accessories for efficient and trouble free operation.

2.00.00 SCOPE OF WORK

2.01.00 Scope of Supply

2.01.01 The work involves timely procurement and transportation to site in properly packed condition of all hardware, materials and miscellaneous items as indicated in the specification and schedules and required to complete the supply & erection job under this specification.

2.01.02 These hardware, materials & miscellaneous items related to sub-station erection shall include but not limited to the following :

- a) ACSR Conductors (Moose)
- b) Tubular Aluminium Bus-bars
- c) Grounding rods, flats, wires
- d) Tension Insulator String Assembly Sets
- e) Suspension Insulator String Assembly Sets
- f) Conductor Spacers, Clamps & connectors, sag compensators
- g) Post insulators
- h) LT power cable termination along with Glands, Lugs etc.
- i) GI cable trays and accessories.
- J) Grounding & earthing materials.
- k) Lightning protection materials.
- l) All cabling materials.
- m) Other item if any.

Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary shall be supplied free of cost to the Employer.

2.01.03 All hardwares, materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.01.04 All relevant drawings, data sheet and technical leaflets on each piece of device

2.02.00 Scope of Services

2.02.01 The work includes but not limited to the following :

Furnishing of all labour, skilled and unskilled, supervisory and administrative personnel, erection tools & tackles, testing equipment, implements, supplies, consumables & hardware for timely and efficient execution of the erection work

2.02.02 Transport vehicles necessary for efficient transportation of equipment from stores to site of erection and excess materials back.

2.02.03 Complete assembly, erection and connection, testing & commissioning, putting into successful & satisfactory commercial operations of the following electrical Equipment and accessories.

- a) 400 KV Outdoor Circuit Breakers.
- b) 400 KV Outdoor Disconnect Switch with or with-out Earthing Switch.
- c) 400 KV Outdoor Current Transformers.
- d) 400 KV Outdoor Potential Transformers.
- e) 400 KV Outdoor Lightning Arresters.
- f) Busbar stringing and equipment connection.
- g) Electrical Relay Panels
- h) Post insulators.

2.02.04 The items of erection work to be performed under cables & grounding with respect to the following equipment/materials :-

- a) Power Cables
- b) Cables laid directly buried in ground/trenches
- c) Control cables
- d) Supply & erection of prefabricated cable trays, cable shaft, supports, brackets & accessories.
- e) Grounding system including lightning protection and underground earthing mat.

2.02.05 Civil & Structural Work

All civil & structural work including supply of labour, materials, tools & tackles, etc. shall be carried out by the contractor in accordance with the attached specification for these works.

3.00.00 DESIGN CRITERIA

3.01.00 Equipment Erection

3.01.01 All the ACSR conductors post and string insulators, clamps & connectors, hardwares etc. will be used in extra high voltage system having characteristics as listed in the annexure.

3.01.02 All equipment, conductors, hardwares, insulators & clamps etc. will be installed outdoor in a hot, humid & tropical atmosphere.

3.01.03 The maximum temperature in any part of the clamps, connectors, conductors etc. at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

3.01.04 All equipment, conductors, clamps, connectors, insulators etc. shall be capable of withstanding the dynamic & thermal stresses of maximum short circuit current without any damage or deterioration.

3.01.05 In order to avoid concentration of stresses, all sharp edges of clamps, connectors etc. shall be rounded off.

3.01.06 Bi-metallic connectors shall be used for any connection between dissimilar materials.

3.01.07 Expansion joints shall be provided in the Aluminium tube bus system, whenever necessary, to eliminate undue stresses on the equipment terminals and post insulator stacks.

3.02.00 Cabling & Grounding Work

3.02.01 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply to all equipment.

3.02.02 The grounding system shall comply with Indian Electricity Rules, I.S. specifications & I.S. Code of Practice.

3.02.03 Suitable embedded steel inserts shall be kept on RCC wall/floor/ceiling surfaces for welding of cable tray brackets. The contractor shall carefully consider those inserts and if necessary shall provide extra anchorings in order to make the cable tray system withstand horizontal/vertical accelerations due to seismic forces for indoor trays as well as outdoor trays and also wind load for outdoor trays.

4.00.00 **SPECIFIC REQUIREMENTS - SUPPLY**

4.01.00 **Equipment & Materials**

4.01.01 Equipment & material shall comply with description, rating, type & size as detailed in this specification and annexures.

4.01.02 Equipment and materials furnished shall be complete & operative in all details.

4.01.03 All accessories, fittings, supports, hangers anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

4.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

4.01.05 After the treatment of steel surfaces damaged during transit sufficient quantity of anti-corrosive paint shall be applied and subsequently finished with two coats of final paint of approved shade.

4.02.00 **ACSR Conductor**

The Aluminium Stranded Conductor and steel reinforced shall have the technical parameters matching with the requirements given in Annexure. These conductors will be utilised for stringing various buses & equipment connections both in switchyard area and transformer yard area. ACSR conductors shall conform to the latest revision of IS-398.

4.03.00 **Clamps and Connectors**

4.03.01 All clamps, connectors and hardwares shall be designed, manufactured and tested as per relevant standards.

4.03.02 All clamps & connectors for connection with equipment or ACSR conductors shall have high tensile aluminium alloy body. U-bolt and nut for the clamp shall be made of non-magnetic material e.g. chromium steel.

4.03.03 Bolt, nut, washer, shackle etc. required for other purpose shall be of forged steel with adequate strength and the surface shall be so protected as to offer maximum resistance to corrosion. Malleable iron wherever used for any part shall be of best quality and shall correspond to latest amendments of relevant IS.

4.03.04 Various fittings & accessories of the clamps & connectors shall be so designed as to eliminate sharp edges & maintain bright smooth surface. All bolts, nuts, rivets etc. shall have round profiles.

4.03.00 **Disc Insulator**

4.03.01 All disc insulators shall be dimensioned appropriately so as to have the required Electro - Mechanical strength for EHV outdoor duties.

- 4.03.02 Suspension & Tension string assemblies shall have adequate number of insulator discs in order to ensure high creepage distance for heavily polluted atmosphere and rain.
- 4.03.03 Suspension and Tension string assemblies shall be supplied as per details given in Annexure. All Insulators and fittings shall generally be supplied as per relevant IS amended upto date.
- 4.04.00 **Post Insulator Stack**
- 4.04.01 Post insulator stack shall be used to support either the ACSR conductor or tubular Aluminium bus of Outdoor EHV switchyard. Insulators shall be solid core polycone type and composed of stacked units. Insulators of identical rating shall be interchangeable.
- 4.04.02 Insulator having sufficient cantilever strength shall be of wet process porcelain, brown glazed and free from all blemishes. Metal parts and hardwares shall be hot-dip galvanised.
- 4.04.03 Insulator shall have adequate mechanical strength and rigidity to withstand the duty involved.
- 4.04.04 When operated at maximum system voltage, there shall be no electrical discharge. Corona/grading ring if necessary, shall be provided with the post insulator.
- 4.04.05 Each post insulator will be mounted on steel structure and shall be complete with necessary fixing clamp at top for clamping of ACSR conductor or tubular Aluminium bus. The insulators shall be provided with necessary nuts, bolts & washers.
- 4.04.06 Post insulator shall conform to the latest amended IS requirements and technical particulars of the stack are given in the enclosed Annexure.
- 4.05.00 **Tubular Aluminium Bus**
- 4.05.01 The material of tubular aluminium bus shall have the technical parameters matching with the requirements given in Annexure.
- 4.05.02 Rigid type tubular Al bus bar arrangement supported on post insulators at intervals is used in outdoor EHV substation. Technical parameters of tubular bus-bar is given in the enclosed Annexure.
- 4.05.03 Tube buses are provided with fixed clamp at one end & sliding/flexible type clamp on the other end for taking care of thermal expansion. Long run of tubular buses shall be complete with suitable internally mounted vibration dampers at intervals in order to achieve quick damping of vibrations arising out of Electro-mechanical forces.
- 4.06.00 **Bundle Spacers**
- 4.06.01 Bundle spacers shall have enough strength so as to restore normal spacing of conductors after displacement by winds, short circuits etc. without damage or permanent deformation. The spacers shall have long life without fatigue or wear

and shall have gentle but firm grip on conductor. They shall be able to withstand all the electromagnetic and electrostatic forces under different operating conditions including dead short circuit.

4.06.02 They shall be of one piece construction and shall not have separate small components.

4.06.03 The materials used in spacers shall be corrosion resistant and made of aluminium alloy of an approved type.

4.06.04 The spacers shall be flexible enough so as to avoid distortion or damage to the conductor or themselves. Rigid spacers are not acceptable.

4.06.05 The spacers shall be capable of being installed or removed from the energised line by means of hot line tools without completely separating the components.

4.07.00 **Cable Trays**

4.07.01 Ladder type cable trays shall be fabricated with 2mm thick M.S angles/flats. The cable trays shall be hot dip gavanized.

The sizes of the trays are as indicated below :

i) 300mm wide & 100mm deep.

ii) 450mm wide & 100mm deep.

iii) 600mm wide & 100mm deep.

4.07.02 The straight sections shall be supplied in 2.5m standard length. For the purpose of fixing coupler joints, the sides of mild steel trays shall have four 10mm diameter holes at each end of straight sections. All trays & coupler joints shall be provided with one coupler joint to extend length of cable tray beyond 2.5m. These coupler joints shall consist of 2.0mm thick sheet with 4 holes on each side.

4.07.03 Cable trays shall be complete with all necessary accessories such as, ground continuity connections, nuts, bolts, washers hangers, clamps, supports etc.

4.08.00 **Conduits & accessories**

4.08.01 Conduits shall be of rigid steel, hot dip galvanized, furnished in standard length of 3 metres, threaded at both ends.

4.08.02 Conduits upto and including 25 mm size shall be of 16 SWG & conduits above 25mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 19 mm.

4.08.03 Each piece of conduit shall be straight, free from blister & other defects, internal surface shall be of smooth finish & covered with capped bushings at both ends.

4.08.04 Flexible conduits shall be made with bright cold rolled, annealed & electro-galvanized mild steel strips coated internally with epoxy .

4.09.00 Cable Termination & Jointing Kits

4.09.01 The contractor shall supply cable termination & jointing kits for L.T. power and control cables along with all accessories.

4.09.02 For the cable termination and straight through joints both L.T. power and control cables, supply of items of jointing kit such, as, necessary boxes, if any, sealing compounds, ferrules, tapes, lugs, glands, shall preferably be of reputable make.

4.10.00 Cable Glands

Cable glands shall be nickel plated brass gland, double compression type complete with necessary armour clamp and tapered washer etc. Cable glands match with the sizes of different L.T. power & control cables.

4.11.00 Cable Lugs

Cable lugs shall be aluminium or copper suitable for termination of different cross-section of L.T. power & control cables. Lugs for power cables shall be compression type whereas lugs for control cables shall be crimping type.

4.12.00 Grounding Work

All materials for grounding work like underground mat, overground bus, risers, structure and equipment connections etc. will be supplied by the contractor. The underground mat and risers will be M.S. rods of adequate dia. Overground bus and equipment connections, etc. will be done by G.I. flats of suitable sizes.

4.13.00 Sag Compensator

4.13.01 It is intended to use sag compensating device to compensate the differential sag of bus due to temperature variations over a range of 0 deg.c to 80°. Stringing chart shall be furnished by Owner to the successful bidder.

4.13.02 The device shall be provided within a suitable enclosure to suit the outdoor weather conditions specified herein.

4.13.03 The device shall be designed for a maximum load of 2000 kg. and shall also withstand the maximum dynamic force due to short circuit. It shall conform to latest revisions of IS : 3195 and IS : 7906 (I & V) or any equivalent standard.

4.13.04 The spring shall be helical and made of high quality spring steel rods formed by centreless guiding. The spring shall be precompressed so that under all conditions the spring will work under compression. The ends of the spring shall be flat, closed and ground.

4.13.05 The tension rods and guide rods shall be made of stainless steel. There shall be three members guide rods arranged in triangular configuration so that stresses developed due to the load coming on the spring is equally distributed on all the bolts. These rods are provided to ensure that the springs remain "Buckle Proof" in all the conditions to ensure that no bolt loosens or, gives way under working conditions.

5.00.00 INSTALLATION - GENERAL

- 5.01.01 Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.
- 5.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- 5.01.03 The equipment shall be furnished in dis-assembled condition as received at site. The Contractor shall assemble all those parts, mount and wire-up loose equipment, fittings and accessories and complete all connections.
- 5.01.04 The equipment will be generally supplied with base frame holding down bolts, nuts, anchors etc. The supporting steel structures shall also be supplied with the circuit breaker. The Contractor shall design, fabricate and supply the supporting structures of all other equipments.
- 5.01.05 All erection work shall be carried out in strict compliance with manufacturer's instructions and shall include all necessary adjustments, checks and measurements.
- 5.01.06 All internal wiring of the equipment which has been left incomplete because of shipping split or which requires minor modifications shall be carried out by the contractor.
- 5.01.07 The contractor shall record results of all erection tests and measurements. The contractor shall submit copies of those test results to the Owner for his reference and record.

5.02.00 EHV Circuit Breaker

- 5.02.01 EHV Circuit Breakers shall be three-phase (3 off 1-pole), SF₆ type. Each pole of the breaker will be separately mounted on steel structure or all the poles mounted on a common structural frame work. There will be a common central cubicle which will house all Electrical, controls, monitoring device etc. except for those items located on each pole. In addition to Central Control Cubicle there may be a Control Cubicle for each Pole.
- 5.02.02 Circuit Breaker may be available in a completely disassembled condition at site packed separately. Contractor shall unpack, assemble, align properly and erect completely each pole on steel structure and shall connect three poles together with their interconnection with common cubicle both mechanically and electrically for smooth functioning.
- 5.02.03 All SF₆ gas pipelines, air compressors compressed air pipelines, valves, pressure switches, gas density monitoring devices, etc. shall be installed in a neat workman like manner complying with I.E. rules, codes of practice etc. The control cubicles shall be installed and all wiring and cabling work shall be done. Necessary settings of air pressure switches, gas density monitoring devices etc. shall be done.
- The breaker shall be filled with SF₆ gas following manufacturer's recommendation regarding vacuum treatment, gas filling etc.

- 5.02.04 The breaker shall then be subjected to pre-commissioning check-ups and tests. Various checks like simultaneous closing of contacts, closing time, opening time, closing resistor pre-insertion time etc. shall be checked with an operational analyzer/oscillograph. The SF6 gas composition and purity shall also be tested.
- 5.02.05 Prior to commissioning of circuit breaker, pre-commissioning tests of various controls, interlocks, protective relays, annunciations, etc. shall be tested. A list of commissioning tests has been given. The list is for indicative purpose and not meant to be exhaustive.
- 5.03.00 **EHV Disconnect Switch**
- 5.03.01 EHV disconnect switch shall be manual/motor operated type with or without manually operated earth switch. Individual poles will be either separately mounted on steel structure or a common structural frame work will accommodate all the three poles.
- 5.03.02 The Contractor shall assemble, align properly and erect completely each pole and shall connect all the three poles with the Central Control Cubicle both mechanically and electrically for smooth and efficient functioning. The earthing switch, wherever called for, shall be mounted on the disconnect switch frame together with Control Cubicle.
- 5.03.03 Disconnect Switch shall be properly stringed to overhead ACSR conductor or AL tube bus-bars as the case may be.
- 5.04.00 **Current and Potential Transformers, Lightning Arrestors.**
- 5.04.01 All C.T. and P.T. shall be single pole oil immersed, self cooled type separately mounted on steel structure. Each C.T. and P.T. will be hermetically sealed and the Contractor shall exercise utmost care in handling and erecting those C.T. and P.T.
- 5.04.02 All the three poles of C.T./P.T. shall have a common terminal box centrally located on the steel structure for wiring. The contractor shall supply and erect above terminal box and wire up each pole upto the terminal block in central terminal box.
- 5.04.03 The contractor shall connect the C.T./P.T. terminals to adjacent equipment/overhead ACSR conductor by AL bus/ ACSR conductor.
- 5.04.04 Lightning arrester shall be station class, heavy duty, metal oxide type being mounted on insulating base and connected to earth through the surge counter. The contractor shall assemble and erect the lightning arrester on steel structure. The upper terminal of L.A. shall be stringed to overhead ACSR conductor and with equipment by clamp, connector and conductor by the contractor.
- 5.05.00 **Switchyard Hardwares and Accessories**
- 5.05.01 The contractor shall assemble, clean and erect carefully all the disc and post insulators necessary for stringing and connections. All the disc insulator strings shall be complete with necessary tension or suspension clamps, arcing horns etc. in the switchyard and transformer yard area.
- 5.05.03 The contractor shall do all the stringing, install the aluminium bus-bar and

connect various equipment in the substation and transformer yard area as shown in the enclosed drawings.

5.06.00 Relay Panels

5.06.01 Relay Panels etc. will be split up in sections for ease of transportation and handling. All breakers, bus-bars, bus wires, relays, meters and control switches will be supplied loose to be mounted and connected at site.

5.06.02 Base frames shall be properly grouted with foundation. Inter-shipping section connections shall be made. If any civil modification work is required, same shall be done by the contractor.

5.06.03 All connections in the switchgear, Control Panels etc. shall be completed, checked and adjusted to ensure safety and satisfactory operation of the equipment.

5.06.04 In some cases, some modifications may have to be carried out at site in the wiring of an equipment to meet the requirements of the desired control scheme.

5.07.00 Steel Fabrication

5.07.01 All racks, supports, hangers and brackets wherever necessary shall be fabricated by the contractor.

5.07.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edges.

6.00.00 INSTALLATION - CABLING & GROUNDING

6.01.00 General

6.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instruction, recommendations where the same are available.

6.01.02 Equipment shall be installed in a neat workmanlike manner so that it is leveled, plumbed, squared and properly aligned and oriented.

6.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches, tunnels, overhead trays, in conduits etc. dressing and clamping, jointing inclusive of supply of necessary jointing kits, lugs, glands, ferrules, tapes etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

6.01.04 Grounding installation work shall mean erection, welding, connection and painting, testing of ground conductors including supply of necessary steel. The work includes the underground mat and overground grounding grid, risers and equipment connections.

6.02.00 Cable Trays

- 6.02.01 The contractor shall supply & install all cable trays, racks, risers, shafts & supports.
- 6.02.02 Cable trays either inside concrete trenches or inside buildings and racks, inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors.
- 6.02.03 The contractor shall have to secure rack/tray supports by welding to these steel inserts embedded in wall/floor/ /ceiling or other available building steel surfaces. Outdoor trays shall be installed by welding on the steel/concrete structures with inserts by the contractor.
- 6.02.04 In case of non-availability of embedded steel inserts in certain tray routes, the contractor shall have to secure the supports on wall/floor/ceiling surfaces by suitable anchoring system having adequate load bearing capacity.
- 6.02.05 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.
- 6.02.06 The cable trays shall be supported in general at a span of 1.5 metres horizontally and at a distance of 1.0 metre vertically.
- 6.02.07 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access for installing and maintaining the cables.
- 6.03.00 **Cable and Conduits**
- 6.03.01 The contractor shall install, terminate and connect all cable and conduits as per approved layout drawings and approved cable schedules.
- 6.03.02 The approved drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Owner's Engineer.
- 6.03.03 During the erection period, the contractor shall furnish a monthly report on cable position in an approved proforma so as to keep the Owner apprised of the position.
- 6.03.04 The contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/ jointing.
- 6.04.00 **Conduit and Accessories**
- 6.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Owner's Engineer.
- 6.04.02 The contractor shall furnish all conduits complete with accessories as required.
- 6.04.03 Conduits shall be flexible or rigid depending upon nature of application.
- 6.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit shall be sealed by suitable sealing compound having fire withstand capability.

6.05.00 Cables : Storage and Handling

- 6.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e. with flange horizontal.
- 6.05.02 Rolling of drums shall be avoided as far as practicable for short distance; the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.
- 6.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.
- 6.05.04 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.
- 6.05.05 The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.
- 6.05.06 While laying cable, cable roller shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance.
- 6.05.07 Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

6.06.00 Cable Laying

- 6.06.01 Cable shall be installed in ladder type trays except for some short run in rigid/flexible conduit for protection or crossings.
- 6.06.02 Cables laid on trays and risers shall be neatly dressed and clamped at an interval of 1500 mm and 900 mm for horizontal and vertical cable runs.
- 6.06.03 Clamps for multicore cables shall be fabricated out of 25x3 mm aluminium flats. All power cables shall be clamped individually and control cables shall be clamped in groups of three or four cables.
- 6.06.04 All single core power cables shall be laid in trifoil formation and suitably clamped with 25 mm wide 14 SWG aluminium strips or fibre glass mould pieces of appropriate quality and sizes.
- 6.06.05 Prior to laying of cables inside both indoor and outdoor trenches, the contractor shall properly clean inside those trenches.
- 6.06.06 In outdoor areas, buried cables, wherever called for, shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.
- 6.06.07 When buried cables cross road/railway track, additional protection shall be provided in the form of hume/ galvanised iron pipes/RCC box culvert.
- 6.06.08 After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.

6.07.00 Cable Tags & Markers

- 6.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, every 30.0 M and exit from any equipment, junction box.
- 6.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire.
- 6.07.03 The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.
- 6.07.04 The contractor shall furnish and install all tags and markers stated above.
- 6.07.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 metres and at every change of direction.

6.08.00 Cable Termination and Connection

- 6.08.01 The termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, approved drawings and/or as directed by the Owner's Engineer.
- 6.08.02 The work shall include all clampings, fitting, fixing, soldering, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be furnished by the contractor.
- 6.08.03 Furnishing of all consumable materials, such as, soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.
- 6.08.04 Cable joint kits for all cables shall be supplied by contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.
- 6.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.
- 6.08.06 The contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.
- 6.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor at the discretion of Owner's Engineer.
- 6.08.08 Control cable cores entering switchgear/distribution board etc. shall be neatly bunched and served with PVC perforated type tape to keep it in position at the terminal block.
- 6.08.09 The contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic and interlocked type.
- 6.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

- 6.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.
- 6.08.12 All cable entry points shall be properly sealed and made vermin and dust-proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.
- 6.09.00 **Cable Joints**
- 6.09.01 Cables shall be installed without joints. However, in exceptional cases, joints may be allowed by Owner for which prior approval has to be taken.
- 6.10.00 **Grounding – Over ground Grid for Equipment Connection**
- 6.10.01 The Contractor shall carry out the grounding and lightning protection of all electrical equipment, steel structures etc. Excavation and backfilling, if required, shall be performed by the contractor at no extra cost.
- 6.10.02 The grounding shall be done by flat of suitable sizes and the same shall be connected to the risers of main ground mat.
- 6.10.03 In case of site fabricated cable tray/ladder, the runner angles if used as ground conductors shall be made electrically continuous.
- 6.10.04 All ground conductor connections shall be made by electric arc welding unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers.
- 6.10.05 All ground conductors shall be painted black for easy identification.
- 6.10.06 Equipment will generally be furnished with two separate ground pads with tapped holes, bolts and spring washers. If, however, the same are not furnished, contractor shall drill and tap holes and provide bolts, spring washer for connection.
- 6.10.07 Equipment ground connections, after being checked and tested by the Employer's Engineer, shall be coated with anti-cor-rosive paint.
- 6.10.08 Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment, switchboards, panels, cabinets, junction boxes, switches, fittings, fixtures, etc. shall be effectively grounded.
- 6.11.00 **Painting**
- 6.11.01 The contractor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of dark admiralty gray (shade no. 632 of IS:5) synthetic enamel paint.
- 6.11.02 All damaged parts shall be cleaned and coated with two (2) coats red oxide primer paint followed by a finishing coat of approved colour. Only touch up painting shall be done.
- 6.11.03 All damaged galvanized surfaces shall be coated with cold galvanising paint.

- 6.11.04 All equipment after erection shall be touch up painted only.
- 6.11.05 All primer and paint including touch up paints shall be supplied by the Contractor.
- 6.12.00 **Grounding - Underground Grounding Mat :**
- 6.12.01 The Contractor shall carry out installation of underground grounding mat of the switchyard area. All materials including ground conductors shall be provided by the contractor.
- 6.12.02 The Contractor will plan and organise work to lay the grounding mat in the same sequence in which the building and equipment foundation is being done. If, however, some additional excavation and back-filling become necessary for the installation of ground mat, same shall be carried out by him.
- 6.12.03 The underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of 500mm below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes.
- 6.13.00 **Ground Electrode**
- Ground electrodes will be 3 metres long M.S. rod of adequate size. These are to be fabricated and driven into the ground by the side of mat conductors. All connections to the conductors shall be done by arc welding process.
- 6.14.00 **Risers**
- Risers are required for connecting the equipment and structures with the ground mat. These will be of M.S. rod, laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free, at least 300 mm above ground level.
- 6.15.00 **Structure Grounding**
- All steel structures are required to be grounded from ground mat. Laying, supporting along with foundation connecting at ground mat are within the scope of this specification.
- 6.16.00 **Lightning Protection**
- 6.16.01 The lightning protection system shall be comprising of shielding mast, down conductor, riser and other accessories required for complete protection of the switchyard.
- 6.16.03 The lightning conductor shall be as straight as possible. Sharp bends shall be avoided.
- 6.16.04 The connections between the conductors shall be electrically continuous.
- 6.17.00 **Foundation & Civil Works**

- 6.17.01 Equipment foundations, equipment mounting structure foundation, and other civil work shall be carried out by the contractor as detailed elsewhere in the specification.
- 6.17.02 All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the contractor including minor modification of civil work as may be required for erection.
- 6.17.03 Any cutting of masonry/concrete work, which is necessary, shall be done by the Contractor and shall be made good to match the original work. The Contractor shall obtain approval of the Owner's Engineer before proceeding with any cutting of masonry/concrete work.
- 6.18.00 **Pre-Commissioning tests at site**
- 6.18.01 The installation of different types of equipment and accessory shall be tested by the contractor after completion of his erection work with an advance notice to the Employer's Engineer concerned so that he may witness the same also.
- The contractor shall prepare pre-commissioning test proforma of each equipment/work/system indicating the data of each equipment/work/system. The test results are to be tabulated. The proforma shall be submitted to Employer for approval.
- 6.18.02 The test result of any installation or equipment or its parts, if considered unsatisfactory to the Employer's Engineer, the concerned installation/equipment and its accessories shall be properly rectified and tested again to the satisfaction of the Employer's Engineer by the Contractor at his own cost.
- 6.18.03 The site tests to be carried out by the Contractor on completion of installation/erection of equipment are broadly listed in Annexure-C for ready reference by contractor. This is just for guideline and additional tests may have to be carried out without any extra charge, if desired by the Employer's Engineer.
- 6.18.04 The major testing equipment which will be necessary for carrying out pre-commissioning tests at site are already listed in this specification.
- 7.00.00 **TESTS**
- 7.01.00 **Routine Tests**
- 7.01.01 During manufacture and on completion, all equipment, clamps, connectors and accessories shall be routine tested as per applicable clause of relevant Indian Standards at manufacturer's works.
- 7.02.00 **Type Tests**
- 7.02.01 Tests certificates for type tests, as stipulated in Indian Standards carried out on similar equipment clamps, connectors etc. shall be furnished.
- All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

7.03.00 Test Witness

7.03.01 All tests shall be performed in presence of Owner's representatives if so desired by the Owner.

7.03.02 The Contractor shall give at least thirty (30) days advance notice of shop tests and seven (7) days advance notice of site tests.

7.04.00 Test Certificates

7.04.01 Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner. The certificates shall furnish complete identification of date including serial number of each material and accessory.

7.04.02 Equipment shall be despatched from works only after receipt of Owner's written approval of shop test reports.

7.04.03 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

7.05.00 Pre-Commissioning tests at site

7.05.01 The installation of different types of equipment and accessory shall be tested by the contractor after completion of his erection work with an advance notice to the Owner's Engineer concerned so that he may witness the same also.

The contractor shall prepare pre-commissioning test proforma of each equipment/work/system indicating the data of each equipment/work/system. The tests results are to be tabulated. The proforma shall be submitted to Owner for approval.

7.05.02 The test result of any installation or equipment or its parts, if considered unsatisfactory to the Owner's Engineer, the concerned installation/equipment and its accessories shall be properly rectified and tested again to the satisfaction of the Owner's Engineer by the Contractor at his own cost.

7.05.03 The site tests to be carried out by the Contractor on completion of installation/erection of equipment are broadly listed in Annexure-C for ready reference by contractor. This is just for guideline and additional tests may have to be carried out without any extra charge, if desired by the Owner's Engineer.

7.05.04 The major testing equipment which will be necessary for carrying out pre-commissioning tests at site are listed below :

- a) Power operated Meggar of 10,000V and 1,000V grade for Insulation testing.
- b) Hand operated Meggar of 1,000V grade for Insulation testing.
- c) Hand driven earth resistance Meggar of range 0 - 1/3/30 ohms.
- d) Tong testers of suitable ranges.

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- e) High potential test set suitable for EHV/HV/LV equipment.
- f) Contact resistance measuring set for Micro - ohms.
- g) Current transformer primary injection set.
- h) Relay testing and checking bench.
- i) Insulating oil testing set.
- j) Stream line filter for insulating oil.
- k) Multimeter, test lamp, field telephone with buzzer set, dB-meter, different gauges, torque wrenches, spirit level etc.

Other test equipment as required shall be arranged by the Bidder.

SECTION-3

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification. The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other respective sections and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a)	Customer/ Purchaser/ Owner	Gujrat State Electricity Corporation Ltd. Vadodara
b)	Consultant	Development Consultants Pvt. Ltd., Kolkata - 700 091
c)	Project Title	400kV Switchyard Extension and 400 kV Switchyard for GIS for 1x800 MW Supercritical Thermal Power Project
d)	Location	Wanakbori is connected with roads by the National Highway, NH-8 (about 10 km from plant -Dakor-Godhra) and state highway SH-59 (about 2 km from plant -Balasinor- Sevalia). Wanakbori is connected with railways by Ahmedabad- Vadodara main Broad Guage line of Western Railway (about 8 km from Sevalia). Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
e)	Elevation above MSL	72.0 meters
f)	Transport Facilities	Road/Rail, Nearest railway station is Sevalia. Nearest Airports are Vadodara at distance of 85 Km from site and Ahemedabad at a distance of 100 Km from the Site.
g)	Postal Address	To follow
METEOROLOGICAL DATA OF SITE IS GIVEN BELOW		
a)	Max. daily average temp	34 °C
b)	Min. daily average temp	11.7 °C
c)	Max. Ambient air temp. (daily)	34°C
d)	Max. Ambient air temp. (yearly)	30°C
e)	Max. Ambient air temp.	42°C
f)	Wet bulb temperature	28°C
g)	Design ambient temp. for all electrical equipment	50°C
h)	Wind Design	Basic Wind Speed, Vb = 39m/s

Gujarat State Electricity Corporation Ltd.
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for 1x800 MW Supercritical Thermal Power Project
Section3

Bharat Heavy Electricals Ltd.

i)	Pollution Severity	Highly Polluted
j)	Seismic Criteria	III
k)	Relative Humidity	100%
l)	Average annual rainfall	750 mm

SITE PROFILE

Location	Wanakbori, District-Kheda, Gujarat
Access by – nearest railway station	Ahmedabad – Vadodara Main Broad Gauge line, Sevaliya (8 KM)
Nearest Airport	Ahmedabad and Vadodara
Nearest sea port	Kandla
Access by Road	10KM from Godhra NH No.8; 02 KM from Balasinor-Sevaliya SH No.59
Major Towns / Cities	13KM from Balasinor and 10KM from Sevaliya
Availability of Land	Within existing Thermal Power Station
Latitude	22° -52'N
Longitude	73° -21'E
Altitude	80Meters from mean sea level for existing Units 70Meters from mean sea level for 800MW Unit 8

3.2 EVACUATION OF POWER

For evacuation of power through outgoing line feeders, 400 KV transmission lines established by GETCO between the proposed power plant and existing 400 KV substation of GETCO. The interface point between this switchyard and 400 KV transmission lines of GETCO will be at the take off gantry structures inside the switchyard fence.

Following title block shall be included in all documents for submission

3.4 SYSTEM PARAMETERS

Gujarat State Electricity Corporation Ltd.
400kV Switchyard Extension and 400 kV Switchyard for GIS
for 1x800 MW Supercritical Thermal Power Project
Section3

Bharat Heavy Electricals Ltd.

Nominal system voltage	400 kV
Highest system voltage	420 kV
Rated lightning impulse withstand voltage	a) ± 1425 kVp between live terminals and earth. b) ± 1665 kVp impulse on one terminal and other terminal earthed (across isolating distance).
Rated one minute power Frequency withstand voltage	630kVrms
Rated switching impulse withstand voltage	1050 kVp (Phase to earth) 1575 kVp (Phase to Phase)
Corona extinction voltage	320 kV
Frequency	50 Hz
Rated short time withstand current capacity	40 kA for 3 sec
Creepage distance	31mm/kV
System Earthing	Effectively Earthed

3.5 AUXILIARY POWER SUPPLY

3 phase A.C power supply	415V, 50 Hz, 3-phase 4 wire, solidly earthed with variation in frequency of $\pm 3/-5\%$ and variation in voltage $\pm 10\%$. For motors above 200W up to 160 KW. Fault level 50 KA symm.
1 phase A.C power supply	240V, 50 Hz, 1-phase, 2 wire, AC supply with variation in frequency of $\pm 3/-5\%$ and variation in voltage $\pm 10\%$. For motors up to 200W, Lighting, space heating, A. C. control & protective devices.
D.C. power supply	220V(variation from 190V to 240V) , 2-wire ungrounded 50V, 2 wire system (+) earthed. D.C. Supply Voltage : 187 to 242 Volt for 220VDC. For D.C. alarm, control & protective devices. Fault level 25* KA (Minimum) * Indicative only; the actual value will be decided by the bidder, after substantiating the same by calculation.
Combined variation of voltage and frequency for AC supply shall be $\pm 10\%$	

3.6 GENERAL CONDITIONS

3.6.1 NAME PLATES (RATING PLATES)

Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name,

type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.

Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.

All trade nameplates and labels shall be in English language. All The size and location of nameplates shall be subject to approval of the Engineer.

3.6.3 Latent Defects:

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.8 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

3.8.1 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

3.8.2 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

3.8.3 Motorized lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings. No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided. Lifting devices like lifting tackles, slings, etc. to be

connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

- 3.8.4 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

3.9 MATERIALS

- 3.9.1 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

- 3.9.2 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application. All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

- 3.9.3 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

- 3.9.5 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

- 3.9.6 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

3.10 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India

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should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing. As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

- a) Width of the Package: 3.2 Meters (from centre-line of rails- 1.6 meters on both sides)
- b) Height of the package from rail top: 4.47 Meters

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorized and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project

site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may consider entire material delivered up to site through rail transportation only. The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of

the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the

office placing the contract, nomenclature of contents and Bill of Material. For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

3.11 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like

items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped. Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

3.12 PAINTING

3.12.1 GENERAL

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least

two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner. All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions.

Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat. Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in

windy weather or near unprotected surfaces of a contrasting color and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment. Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use. Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior

factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting

instructions shall be furnished. Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C. The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

3.12.2 PREPARATION

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying. Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed. The priming coat shall be applied without delay.

3.12.3 DAMAGED PAINTWORK

Any damaged paintwork shall be made good as follows:

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

3.12.4 PAINTING SYSTEMS

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

- a) Surfaces Subject To Weathering
All surfaces shall have a minimum of four coats of paint made up as follows:
Primer coat: 35 micron DFT
Tie coat: 35 micron DFT
Finishing coat (2 Nos.): 35 micron DFT per coat
The total minimum DFT shall be 140 micron.
- b) Surfaces Inside Buildings
All surfaces shall have a minimum of three coats of paint made up as follows:
Primer coat : 35 micron DFT
Tie coat : 35 micron DFT
Finishing coat (2 Nos.) : 25 micron DFT per coat
The total minimum DFT shall be 120 micron.
The type and colour of primer & finish coat shall be selected by the Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this

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specification.

3.12.5 COLOUR CO-ORDINATION & FINISH

3.12.5.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

3.12.5.2 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

3.12.5.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

3.12.5.4 Final colours and finishes shall be to the Approval of the Engineer.

3.13 NOISE LEVEL REQUIREMENT

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.

c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

3.14 INSPECTION AND TESTING

3.14.01 Inspection and Tests during Manufacture

3.14.02 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

3.14.03 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

3.14.04 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

3.14.05 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of

manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable

notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results. The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose. Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library /record.

3.14.06 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

3.14.07 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to dispatch from place of manufacture.

3.14.08 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

3.14.09 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

3.14.10 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

3.14.11 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing

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shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radio graphed.

- 3.14.12** Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

3.15 PERFORMANCE TESTS AT SITE

- 3.15.01** The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 3.15.02** The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 3.15.03** The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre commissioning to tests on completion and commissioning of the complete system/equipment.
- 3.15.04** For details of specific tests required on individual equipment refers to respective section of this specification

3.16 PACKING FOR SHIPMENT

- 3.16.01** The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and weather conditions involved. The Contractor shall submit the packaging method for shipment to be adopted by him, if so desired by the Owner / Purchaser.
- 3.16.02** Each consignment shall be marked with Equipment name, Owner /Purchaser's name & address, Project details, handling instruction etc. It shall be complete with part list and identification details. The copies of the part list of each consignment shall also be furnished to the Owner / Purchaser after dispatch.
- 3.16.03** Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The contractor shall obtain approval from concerned authorities for transportation

of over dimensioned consignment/package, if any, before starting manufacture of such equipment.

3.17 TYPE & RATING OF EQUIPMENT

- 3.17.01** The number of types and sizes of motor, controls, and other electrical equipment shall be kept to a minimum so that the requirement of spares is minimized.
- 3.17.02** Equipment shall be rated for the load and duty cycle of the intended service Circuit breakers and fuses shall be rated to withstand and interrupt the maximum fault current at the point of application in the circuit.

3.18 TROPICAL PROTECTION

- 3.19.01** All electrical equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 3.19.02** Fine mesh screen of corrosion resistant material shall be furnished on all ventilating openings to prevent entry of insects.

3.20 ELECTRICAL SWITCH BOARDS

3.20.01 GENERAL

Switchboards shall be dead-front, free-standing, vertical, cubicle/panel type, completely wired, having access doors with concealed hinges and locking type latches.

- 3.20.02** Panels shall be fabricated from minimum 1.6mm thick for non-load bearing members & 2 mm thick for load bearing members, CRCA (cold rolled continuously annealed) sheet steel, free from any surface imperfections and suitably reinforced to provide a sturdy and rigid assembly. Load bearing wall/covers/back covers shall be 2 mm thick and for non-load bearing the wall/cover/back cover shall be 1.6 mm thick.
- 3.20.03** Panels shall be adequately sized for installation of field cables and access for maintenance. The working zone shall be limited between 300 mm and 1800mm from floor level.
- 3.20.04** Each panel shall be provided with internal illumination lamp operated by door switch, thermostat controlled space heater with miniature circuit breaker (MCB) unit, and plug socket with MCB for hand lamp.
- 3.20.05** Removable eye bolt/lifting lugs shall be furnished on all panels.
- 3.20.06** Unless otherwise stated, equipment rating and module sizes shall be as per annexure B. Module selection chart is specified for guidance of bidder in respect to requirement of module space and component ratings.

3.21 EQUIPMENT MOUNTING

- 3.21.01** All instruments, switches etc. mounted on the front face of the panels shall be of flush type.
- 3.21.02** All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.
- 3.21.03** All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.
- 3.21.04** At least 20% with a minimum of one spare feeders of each type & rating shall be provided in MCC/Switch Board.

3.22 PANEL WIRING

- 3.22.01** All panels shall be fully wired at the factory to ensure proper functioning of all control, protection and interlock schemes. All wiring for external connections shall be brought to terminal blocks and numbered.
- 3.22.02** Panel wiring shall be carried out with flexible, 1100 grade, heat as well as fire resistance type PVC insulated stranded copper wire of minimum 2.5 Sq.mm(7/0.67mm) cross section.
- 3.22.03** Solder less compression/clamp type connection shall be used for wire terminals. Wiring shall be continuous between terminals without splicing. Each wire shall be identified at both ends with permanent markers having wire numbers as per approved wiring drawings.
- 3.22.04** All spare contacts of relays, aux. relays, contactors, aux. contactors, switches, push buttons etc. shall be terminated up-to external terminal block.
- 3.22.05** Terminal blocks shall be Box clamp type with marking strip. Not more than two wires shall be connected to one terminal. Spare terminal equal in number to 20% of active terminals shall be furnished.

3.23 GROUNDING

A copper ground bus for HT Switchgear and GI ground bus for LT boards, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid. Minimum size of ground bus shall be 75 X 10 sq. mm.

3.24 PAINTING

All metal surface shall be cleaned, phosphated and given two coats of rust-resistant primer followed by two coats of epoxy based finish paint. The shades for different equipment shall be as follows:

- a) For switchgears, MCCs, Distribution boards and other panels-Light Grey RAL 7032.
- b) For transformer –Battle ship Grey shade 632 of IS-5.

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- c) For motors-Battle ship grey shade 632 of IS-5
- d) For generator isolated phase Bus duct enclosure –Inside shall be Matt Black & outside will be light grey shade RAL 7032 for indoor part and battle ship grey shade 632 of IS-5 for outdoor. All supporting steel structures shall be galvanised. HT and LT Bus duct shall be same as generator Bus duct.

3.25 NAME PLATE

Name plate of approved design shall be furnished on each panel and for each instrument or device mounted on panel. The material for name plate shall be 3 mm thick lamicoide or approved equal, with white letters on black background.

3.26 TESTS

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

3.27 SPECIAL CABLES

Special cables for specific purpose, as required, shall be supplied and installed by the EPC Contractor.

3.28 CONDUITS

3.28.01 Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square, reamed, threaded and screwed tight at all joints.

3.28.02 Conduit entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

3.28.03 Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.28.04 HDPE PVC pipes shall be used for single core power cables.

3.29 SPECIFIC REQUIREMENT - SERVICES (DESIGN & INSTALLATION)

3.29.01 Methods and Workmanship

3.29.02 All equipment shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

3.29.03 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

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3.29.04 All details on installation shall be electrically and mechanically correct.

3.29.05 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

3.30 PROTECTION OF WORK

3.30.01 For protection of this work, the Contractor shall provide fencing and lighting arrangement, connect space heaters and provide heating arrangement as necessary or as directed by the Owner/Consultant.

3.31 ANNEXURE-B: MODULE SELECTION

MOTOR FEEDER

Type Motor Rating MCCB Rating Contactor Cable size

AU/AR 0 - 5.5 KW 32A 16A 3/c – 2.5 Sq.mm - Cu

BU/BR 5.6 - 11 KW 63A 32A 3/c - 16 Sq.mm - Al

CU 11.1 - 22 KW 63A 63A 3/c - 35 Sq.mm - Al

DU 22.1 - 50 KW 100A 100A 3/c - 95 Sq.mm - Al

EU 50.1 - 75 KW 200A 160A 3/c - 185 Sq.mm - Al

FU 75.1 - 110 KW 400A 300A 2 x 3/c - 185 Sq.mm - Al

NOTE :

1. MCCB with short circuit release, thermal overload relay with SPP feature, Contractor are to be co-ordinate (Type-2) with motor rating by the Contractor.

2. “U” stands for Undirectional and “R” for Reversible drives.

OUTGOING FEEDER

Type MCCB Rating Cable Size

AF 32A 4/c – 16 Sq.mm - Cu

BF 63A 4/c – 35 Sq.mm - Al

CF 100A 3.1/2 – 95 Sq.mm - Al

DF 200A 3.1/2 – 300 Sq.mm - Al

EF 400A 4 x 1/c – 630 Sq.mm - Al

Note: Cable sizes as indicated above are indicative. However EPC contractor shall submit the sizing calculation of cable and select the cable accordingly.

3.32 ANNEXURE-C: TECHNICAL PARAMETERS FOR ELECTRICAL SYSTEM

L.V. SYSTEM DATA

1	Nominal 3 phase voltage to be selected for L.V. system	415 V
2	Type of Breaker to be selected	Air break
3	Type of outgoing feeder switching device in L.T. MCC	MCCB
4	M.C.C. type	Single front/Double front Fully draw out type
5	Short circuit level for 1 sec	50 KA

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DC. SYSTEM DATA

1	Nominal voltage to be selected for DC system	220 V
2	Type of Incoming / outgoing feeder switching device	Double pole Switch-Fuse
3	DCDB type	Single front/Double front Fully draw out type
4	Short circuit level for 1 sec	To be decided by Bidder 25 KA (minimum)

UPS SYSTEM DATA

1	Nominal voltage to be selected for UPS system	240 V, 1-Ph, 50 Hz, AC
2	Type of Incoming / outgoing feeder switching device	MCCB
3	UPSDB type	Single front, Fixed type, Modular construction
4	Short circuit level for 1 sec	To be decided by bidder 25 KA (minimum)

3.33 CODES AND STANDARDS

All materials and equipment shall generally comply in all respect with the latest edition of relevant international electro-technical commission (IEC) or any other internationally accepted standard which ensure equal or better quality or relevant Indian standard(IS) mentioned against each equipment and this specification.

3.34 MATERIAL/WORKMANSHIP

3.34.01 General Requirement

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood that the same must be new, of highest grade of the best quality of their kind conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the

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Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be constructed as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacture's limits suitable guards shall be provided for the protection of personal on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purpose. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

3.34.02 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

3.34.02 COLOUR SCHEME AND CODES FOR PIPE SERVICE

All steel structures, plates etc shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

3.34.03 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall

be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.34.04 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.34.05 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external painting shall be as per shade no. 631 of IS:5.

3.34.06 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

3.34.07 PACKING

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The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.
- e) Net weight.
- f) Gross weight.

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the purchaser, the Contractor shall also submit packing details/associated drawing for any equipment material under his scope of supply, to facilitate the purchaser to repack any equipment/ material at a later date, in case the need arises. Any material found short inside the packing cases shall be supplied by the supplier without any extra cost. The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbol i.e. fragile, handle with care, use no Hooks etc.

3.34.08 HANDLING, STORING AND INSTALLATION

Contractor may engage manufacturer's Engineers to supervise if required for unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than one section, contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning.

Contractor shall be responsible for examining all the shipment immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. Any demurrage, pilferage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. The Contractor shall be fully responsible, for the equipment/material until the same is handed over to the purchaser in an operating condition after commissioning.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the

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Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

3.34.09 DEGREE OF PROTECTION

The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes panels etc to be installed shall be provided with degree of protection as detailed here under:

- a) Installed out door: IP-55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area IP:52
- d) Installed indoor-in non air-conditioned area where possibilities of entry of water is limited:IP-41
- e) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS: 13947, (Part-1)/IEC-947(Part-1). Type test report/or degree of protection test on each type of the box shall be submitted for approval.

3.34.10 RATING PLATES, NAME PLATES AND LABELS

Type or serial number together with details of the loading conditions under which the item of the substation in question has designed to operate and such diagram plates as may required by the Purchaser. The rating plate of each equipment shall be according to IEC requirements.

All such nameplate instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternately two separate plates one with Hindi and other with English inscriptions may be provided.

3.34.11 EARTHING

Circuit breakers, LA, Isolator, CVT , CT , BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.34.12 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to

terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm, copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible..

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

3.34.13 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel or aluminium and shall be dust, water and vermin proof. Sheet used shall be least 2.0 mm cold rolled or 2.5mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminium enclosed box the thickness of aluminium shall be such that it provides adequate rigidity and long life as comparable with sheet of specified thickness. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting atleast 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project atleast 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required

3.34.14 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.

One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heater shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heater to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centered in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material having equal heat conduction and electrical insulation properties, or they shall consist of a resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and air. Alternatively, they shall consist of resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in glaze the surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments

3.35 DOCUMENTATION

3.35.01 LIST OF DOCUMENTS

The bidder shall submit a detailed list of drawings / documents along with the bid proposal which he intends to submit to the Employer after award of the contract.

The supplier shall necessarily submit all the drawings / documents unless any thing is waived.

All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under this specification shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

3.35.02 DRAWINGS

All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnection between various portions of equipments and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, name of consultant, the unit designation, GSECL contract no. , and the name of the Project .If

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standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer if so required.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawing shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

3.35.03 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer. The following schedule shall be followed generally for approval.

i.	Approval/comments/by employer on Initial submission	Within 2 weeks of receipt
ii.	Resubmission	Within 2 (two) weeks (whenever from date of comments required) Including both ways postal time.
iii.	Approval or comments	Within 2 weeks of receipt of resubmission
iv.	Furnishing of distribution copies	2 weeks from the date of last approval.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

The title block of drawings shall contain the following information incorporated in all contract drawings.

Customer: Gujarat State Electricity Corporation Ltd.

Consultant: Development Consultants Pvt. Ltd., Kolkata

Project: 400kV Switchyard (extn.) & 400kV GIS for 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

NOA NO.

3.35.04 DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

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- 1) Drawings
- 2) Guaranteed Technical Particulars
- 3) Type Test Reports
- 4) Manufacturing Quality Plan

3.35.05 DOCUMENTATION SCHEDULE

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	10	13	-
2	Drawings "As Built "	-	-	13	05
3	Type Test Reports	1	05	13	-
4	Erection Manuals	-	11	13	-
5	Operation and Maintenance Manuals	-	11	13	-
6	Manufacturing Quality Plan	1	11	13	-
7	Field Quality Plan	1	11	13	-
8	Inspection Test Reports	-	-	13	-

Drawings will also be submitted in mini cartridges in AUTOCAD Release -2008 package or any other CAD package along with conversion files for all major items.

Final Documentation shall be submitted in bound volumes with Customer & Project etc. written on top.

3.35.06 AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the specification.

On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/ Specification /Parameter Sheets Duly Signed by the Competent Authority.

3.35.07 DRAWINGS, DATA, INFORMATION AND MANUALS

3.35.08 Drawings, data, information & manuals shall be submitted as indicated below:

3.35.09 To be submitted after award of the Contract.

- a) Single line diagram giving rating of each equipment.
- b) Design calculations in support of selection of equipment rating and system design.
- c) Technical Data sheets, characteristic curves.
- d) Equipment layouts, layout of switchyard with sections.
- e) Grounding & lightning protection drawings and details.
- f) Cabling, cable trench and tray layouts with section and details with cable sizing calculation.
- g) Dimensional general arrangement drawing along with cross- sections for equipment.
- h) Foundation plan and loading data : design calculation and detail drawing of foundation.
- i) Design calculation and detail drawing for civil work related to this specification.
- j) Design calculation, GA drawing for GI structure and equipment supporting structure, and subsequently detailed drawings.
- k) Mounting details of equipment and structure.
- l) Fire fighting and sump arrangement.
- m) Control & operation write up/Block logic diagrams.
- n) Control schematic and wiring diagram.
- o) Cable schedule and interconnection and cable routing.
- p) Relay co-ordination.
- q) Civil & structural analysis, design calculations and working drawings including bar bending schedule and fabrication.
- r) Erection and maintenance manual.
- s) Any other drawings & data as required for satisfactory installation, operation & maintenance.

3.35.10 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

- (i) The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hardcopies.
- (ii) The information provided, which shall be contained in loose leaf stiff backed covers, shall include :
 - a) A complete inventory of all main items of plant, with identification details.
 - b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
 - c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
 - d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of

troubles & faults.

e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.

f) Manufacturer's literature.

(iii) The instruction manual shall be subject to the approval of Owner.

3.35.11 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the letter of award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.

3.35.12 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVALPROCEDURE

(i) Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document. The documents shall be divided into two categories:

a) for approval and

b)for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow four (4) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

(ii) All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation. All dimensions shall be in metric units. All notes, markings etc. shall be in English.

(iii) Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/ information of the Owner/Engineer.

(iv) Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:

a) List of sub-vendors (from Owner only)

b) System scheme and instrumentation diagrams

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- c) Design basis justifying selection of equipment & process parameters where not specified in the Contract
 - d) Equipment data sheets and general arrangement drawings
 - e) Materials of construction
 - f) Layout drawings.
 - g) Operation logic diagrams.
 - h) Typical control circuit.
 - i) Drawings of Instrumentation and control.
- (v) Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.
- a) Equipment foundation drawings.
 - b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
 - c) Predicted performance curves of equipment.
 - d) Various bills of quantity, schedules etc.
 - e) Piping fabrication drawings, isometrics etc.
 - f) Panel wiring diagrams.
 - g) Instruction/Operation manuals.
 - h) Service manuals and trouble shooting guide for C & I system including field instruments.
 - i) Cable schedule and interconnection chart.
 - j) Drive/feeder wise control scheme showing all external interfaces.
- In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.
- (vi) Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:
- a) Approved.

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- b) Approved except as noted, forward final drawing
- c) Approved except as noted, resubmission required.
- d) Disapproved.
- e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document. Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.

The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements. The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

- (vii) Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.
- (viii) For review by the Consulting Engineer, the Contractor shall furnish softcopies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorized revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.
- (ix) In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.
- (x) For details of documentation for Civil, Structural and Architectural works, Vol.II-G may be referred.

3.36 QUALITY ASSURANCE

3.36.01 The Contractor shall follow his standard procedures for quality assurance and control. A copy of the

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said standard procedures shall be submitted to the Owner / Purchaser for his reference. However, Owner / Purchaser reserves the right to review the same and give his observations, if any, for compliance.

3.36.02 The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.

3.36.03 The Owner / Purchaser shall inform the Contractor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner / Purchaser. The contractor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.

3.36.04 Manufacturing and quality control procedures shall be available for audit to the Owner / Purchaser and/or its representative at the place of manufacture.

3.36.05 The Owner / Purchaser reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

3.36.06 The Owner / Purchaser may inspect the Contractor's facilities prior to award of contract.

3.36.07 The Owner / Purchaser may witness any or all of the tests stipulated in the relevant standards and this specification.

3.36.08 The Owner / Purchaser may conduct surveillance of the Contractor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

3.36.01 QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorized representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:

- a) His organization structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.

- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorizing release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.
- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorized representative for approval. Schedule of finalization of such quality plans will be finalized before award.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organization, during various stages of site activities from receipt of materials/equipment at site.
- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorized representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorized representative and beyond which the work will not proceed without consent of Owner/Authorized representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorized representative for approval and dispositioning.
- 2.05.00 No material shall be dispatched from the manufacturer's works before the same is accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorized representative, and duly authorized for dispatch issuance of Material Dispatch Clearance Certificate (MDCC).
- 2.06.00 Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.
- All brazers, welders etc. employed on any part of the contract at Contractor's/Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorized representative.
- For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.
- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for approval.
- 2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including

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castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalized with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalized and approved by the Owner/Authorized representative and form part of the Purchase Order between the Contractor and the Vendor.

2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalized with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.

2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.

2.14.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 QUALITY ASSURANCE DOCUMENTS

3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after dispatch of the equipment:

- a) Material mill test reports on components as specified by the specification.
- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.

h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :

- i) When some important repair work is involved to make the job acceptable.
- ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalized specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Engineer, his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such certificate shall not prevent the Contractor from proceeding with the works.

The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge

such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/Inspector or to his authorized representative to accomplish testing.

- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & maintenance of the equipment. These special tools will also include special material handing equipment, jigs & fixtures for maintenance and calibration/re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for and the price of each tool/tackles shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

- 2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with desiccator's packs as necessary.
- 2.01.02 Each spare part shall be clearly marked or labeled on the outside of the packing with the description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
- 2.01.03 All cases, containers or other packages are liable to be opened for examinations may be considered necessary by the Engineer.

- 2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be dispatched before the dispatch of the associated main equipment.
- 2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30years after commissioning of the plant.
- 2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is later. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.
- 2.02.00 Recommended Spares
- 2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.
- 2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalized after mutual discussion.
- 2.03.00 Start-up Commissioning Spares
- 2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.
- 2.03.02 The Contractor shall submit a complete list of all such start-up spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.
- 2.04.00 Mandatory Spare Parts
- 2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above. Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of

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this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

- 2.04.02 Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The Bidder shall include in his proposal, on the basis of these guidelines, an item wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.
- 2.04.03 The mandatory spares should be supplied to the Owner at least one month before the trial run. The dispatch programme is subject to approval of the Owner/Consultant after award of contract.

ANNEXURE-I

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company/ Contractor	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev. No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

Note: All the information for QAP as stipulated above shall be finalized and agreed during contract execution.

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT : FWS NO :
CONTRACTOR : REV NO. :
PACKAGE : FIELD WELDING CODE :
SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks
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The Field Welding Schedule should be submitted for :

- o Pressure Parts
- o Tanks/Vessels
- o Piping
- o Heavy/Important Structural Steel
- o Heat Exchangers
- o Bus Ducts

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SECTION 4

GAURANTEED TECHNICAL PARTICULARS

SCHEDULE-III C/16, ILLUMINATION SYSTEM

SCHEDULE-IIIC/16

ILLUMINATION SYSTEM

Sl. No.	Description	Make	Cat No.	IS Ref.	Degree of Protection	Finish				Sheet Steel thickness of Reflector	Control Gear type		
						Outside		Inside					
						Colour	Shade No. (As per IS-5)	Colour	Shade No. (As per IS-5)		Integral (Yes/ No)	Non-Integral (Yes/No.)	Cat No. if Non-integral type

1.0 LIGHTING FIXTURES

1.1 Fixture

Type-A(1)

Type-A(0)

Type-DC(cmp)

Type-DA

Type-DB

Type-DC

Type-DF

Type-FP

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Sl. No.	Description	Make	Cat No.	IS Ref.	Degree of Protection	Finish				Sheet Steel thickness of Reflector	Control Gear type		
						Outside		Inside					
						Colour	Shade No. (As per IS-5)	Colour	Shade No. (As per IS-5)		Integral (Yes/No)	Non-Integral (Yes/No.)	Cat No. if Non-integral type

Type-LB

Type-LD

Type-HB

Type-MB

Type-EL

Type-NY

Type-DL

Type-DE

- 1.2 Catalogue for all the fixtures furnished ? :
- 1.3 Electrical and Optical Characteristics given in Catalogue guaranteed ? :
- 1.4 If not, furnish guaranteed characteristics. Attach separate sheets, if required :
- 1.5 Polar curve/light distribution diagram for all fixtures furnished :
- 1.6 Utilisation factors for different room index for each fixture furnished ? :
- 1.7 Isolux diagram for street lighting fixture furnished ? :
- 1.8 Nominal working voltage :
- 1.9 Power factor at nominal working voltage and frequency :
- 1.10 Full load input current at nominal working voltage :
- 1.11 Power loss per ballast at nominal working voltage and frequency :
- 1.12 Maximum permissible supply voltage variation for satisfactory operation of fixture :
- 1.13 Characteristics of fixture furnish for all types of luminaires -
 - a) Starting current and power factor :
 - b) Operating current and power factor :
 - c) Operating time :

Make	Average life- hrs	Lumen Output	Temo. Voltage	Cat. No.	Type of Lamp Base / Cap
------	----------------------	-----------------	------------------	----------	----------------------------

1.14 Lamps

a) Incandescent lamp

100W GLS :

100W Comptalux :

b) Fluorescent tube

28W - Cool daylight :

28W - White :

c) High Pressure Sodium
Vapour (HPSV)

70W :

150W :

250W :

400W :

d) High Pressure Mercury
Vapour (HPMV)

125W :

e) CFL

9W :

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Make		Cat.No.		Rating		Max. operating temp. (tw)		Average life-hrs.	
Fluorescent	HPSV & HPMV	Fluorescent	HPSV & HPMV	Fluorescent	HPSV & HPMV	Fluorescent	HPSV & HPMV	Fluorescent	HPSV & HPMV

1.15 Control Gear

- a) Ballast :
- b) Capacitor :
- c) Starter :
- d) Igniter :
(Separate type)

1.16 General

Any other items which are not indicated in this sheet

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2.0 MLDB & EMLDB/DCELDB/LP/
SLP/DCELP/FLP

2.1 Make :

2.2 Type :

2.3 Reference Standard :

2.4 Enclosure

a) Sheet metal thickness mm :

b) Degree of protection for
Indoor Panel :

Outdoor Panel :

2.5 Bus-Bars

a) Material :

b) Size :

2.6 Bus Rating

a) Continuous at 50 Deg.C Amp. :

b) 1 Sec. Current KA rms :

c) Maximum temperature rise
over 50 Deg.C. ambient Deg.C. :

2.7 Cable gland furnished ? :

2.8 Finish

a) Colour :

b) Shade IS-5 # :

2.9 Ground Bus

a) Ground Bus furnished ? :

b) Material :

c) Size :

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2.10	Dimension & Weight		L x B x H mm	Weight Kg.
a)	MLDB & EMLDB	:		
b)	DCELDB	:		
c)	LP-1	:		
d)	LP-2	:		
e)	LP-3	:		
f)	SLP	:		
g)	DCELP	:		
h)	FLP	:		
2.11	Switch			
a)	Make	:		
b)	Type	:		
c)	Reference Standard	:		
d)	Rating	Amps	:	
2.12	Miniature Circuit Breaker (MCB)			
a)	Make	:		
b)	Type	:		
c)	Reference Standard	:		
d)	Rated Voltage	:		
e)	No. of Poles	:		
f)	Frequency	:		
g)	Current Rating :			
i)	Continuous at 50 Deg.C	Amps	:	
ii)	1 Second	KArms	:	
h)	Breaking Capacity :			
i)	Symmetrical	KArms	:	
ii)	Asymmetrical	KArms	:	

- i) Interrupting time mS :
- j) Type of Blow out device :
- k) Type of overload :
- l) Terminal suitable for cable size :
- m) Catalogue furnished ? :

2.13 Timer Switch

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Rating/Range :
- e) Catalogue furnished ? :

2.14 Fuse

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Rupturing capacity (Sym.) Karms :
- e) Continuous current at 50 Deg.C ambient and within cubicle :
- f) Cut off current KA peak :
- g) Fuse characteristics furnished for various fuse ratings :

2.15 Magnetic Contactor

240V A.C. 220V D.C.

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Rating :
- e) Duty class :
- f) Utilisation category :

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- g) Operating Coil :
- i) Rated Voltage :
 - ii) Drop-out Voltage :
- h) Catalogue furnished ? :
- i) No. of contacts furnished :
- i) Normally open (N.O) :
 - ii) Normally closed (N.C) :
- j) Rating of N.O/N.C contacts :
- i) Make and continuous Amps :
 - ii) Break (Inductive) Amps :
- 2.16 Indicating Lamps (LED Type)
- a) Make :
 - b) Type :
 - c) Cat. no. :
 - d) Voltage :
- 2.17 Push Button
- a) Make & Type :
 - b) Contact Rating :
- 2.18 Meter
- | | Ammeter | Voltmeter |
|-----------------------|---------|-----------|
| a) Make | : | : |
| b) Type | : | : |
| c) Reference standard | : | : |
| d) Size | : | : |
| e) Scale | : | : |
| f) Accuracy Class | : | : |

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2.19 Current Transformer

- a) Make :
- b) Type :
- c) Reference standard :
- d) C.T. Ratings :
 - i) Current Ratio :
 - ii) Accuracy Class :
 - iii) Rated Burden :

3.0 RECEPTACLES (With Plug)

240V A.C 415V
5A 15A 63A 125A

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Catalogue furnished ? :

4.0 CEILING FAN

Fan Regulator

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Sweep of the Fan mm :
- e) Regulator control smooth or step :
- f) Catalogue furnished ? :

5.0 LIGHTING POLE/TOWER
FOR FLOODLIGHTING

Street Light Flood Light
Poles Tower

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Height – Overall m :

- Fixture mounting m :
- e) Catalogue sheet furnished ? :

6.0 LIGHTING TRANSFORMER

6.1 General

- a) Make :
- b) Type :
- c) Reference Standard :

6.2 Rating

- a) Rated output KVA :
- b) Type of Cooling :
- c) Rated Voltage Volt
 - Primary :
 - Secondary :
- d) Rated Current Amps.
 - Primary :
 - Secondary :
- e) No. of phases :
- f) Rated Frequency Hz :
- g) Vector Group reference :

6.3 Temperature

- a) Reference ambient temperature 50 Deg.C :
- b) Temp. rise over reference ambient :
 - i) On enclosure by thermometer Deg.C :
 - ii) In winding by resistance Deg.C :

6.4 Tappings

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- | | | |
|-----|--|---------|
| a) | Type | : |
| b) | Capacity | : |
| c) | Range - Steps x % Variation | : |
| d) | Taps provided on H.V. winding | : |
| 6.5 | Insulation Level | KV/KVp |
| a) | Primary | : |
| b) | Secondary | : |
| c) | Secondary neutral | : |
| 6.6 | Impedance at principal tap
rated current & frequency | % |
| a) | Impedance | : |
| b) | Reactance | : |
| c) | Resistance at 75 Deg.C | : |
| d) | Zero sequence Impedance | : |
| e) | Zero sequence capacitance of
H.V. winding | uf/ph : |
| 6.7 | Guaranteed losses at Principal
tap, full load and 75 Deg.C KW | |
| a) | No load losses | : |
| b) | Load losses | : |
| 6.8 | Efficiency at 75 Deg.C and
0.8 power factor lag | % |
| a) | At full load | : |
| b) | At 3/4 full load | : |
| c) | At 1/2 full load | : |
| d) | Maximum Efficiency | : |
| e) | Load and power factor at
which it occurs | : |

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- 6.9 Regulation at full load and 75 Deg.C %
- a) At unity power factor :
- b) At 0.8 power factor lagging :
- 6.10 No load current referred to HV Amps.
- a) At 90% rated voltage :
- b) At 100% rated voltage :
- c) At 110% rated voltage :
- 6.11 Approximate maximum flux density Web/Sq.m
- a) At 90% rated voltage :
- b) At 100% rated voltage :
- c) At 110% rated voltage :
- 6.12 Maximum current density Amps/Sq.cm
- a) Primary winding :
- b) Secondary winding :
- 6.13 Withstand time without injury for Sec.
- a) Three phase dead short circuit at terminal with rated voltage maintained on the other side :
- b) Single phase short circuit at terminal with rated voltage maintained on other side :
- 6.14 Details of Enclosure
- a) Material :
- b) Thickness mm :
- c) Degree of protection :
- d) Padlocking provisions :

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6.15 Core

- a) Type - Core or Shell :
- b) Core material :
- c) Thickness of lamination mm :
- d) Insulation of lamination :

6.16 Coils

- a) Type of coil :
 - i) Primary :
 - ii) Secondary :
- b) Conductor material :
- c) Insulating material :
- d) Separate encapsulation for Primary and Secondary windings provided ? : Yes/No

6.17 Tap-Changer

- a) Tap-changer operable at standing height from ground ? :
- b) Provided with arrangement to ensure that same tap is set on all three phases at a time ? :
- c) All contacts silver plated ? :

6.18 Bushings

Primary Secondary

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Voltage class KV :
- e) Creepage distance mm/KV :
- f) Weight :

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- g) Free space required for bushing removal :
- 6.19 Minimum Cleaances **Primary Secondary**
- a) Between phases mm :
- b) Between phase & earth mm :
- 6.20 Terminal Connections
- a) Primary :
- b) Secondary :
- c) Secondary Neutral :
- 6.21 Junction Box
- a) Provided with removable gland plate/conduit knock out :
- b) Degree of protection :
- 6.22 Terminal Blocks
- a) Make :
- b) Type :
- c) 20% Spare terminals furnished ? :
- 6.23 Wiring
- a) Cable type :
- b) Voltage grade Volt :
- c) Conductor size - Sq.mm :
- 6.24 Trip & Alarm Contacts Ratings
- a) Voltage Volt D.C. :
- b) Rated/Making Current Amps. :
- 6.25 Accessories
- Each transformer furnished with fittings and accessories as per Annexure-F to Section-VII of Volume-II F/2 :
- 6.26 Approximate Overall Dimension

13)

- a) Length mm :
- b) Breadth mm :
- c) Height mm :
- d) Crane lift for untaking
core and coil assembly
(including sling) mm :

6.27 Approximate Weights

- a) Core and Coil Kg. :
- b) Enclosure & fittings Kg. :
- c) Total weight Kg. :

6.28 Shipping Data

- a) Weight of the heaviest
package Kg. :
- b) Dimension of the largest
package (L x B x H) mm :

7.0 PORTABLE EMERGENCY LIGHTING UNIT

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Catalogue no. :
- e) Overall dimension and weight
(L x B x H) (mm x mm x mm) (Kg.) :
- f) Lamp
 - i) Type :
 - ii) Make :
 - iii) Voltage Watts :
- g) Storage Cell
 - i) Make :
 - ii) Type :

(12)

iii)	Voltage	Volts D.C	:	
h)	Duration of lamp glowing after failure of AC supply		:	
8.0 MISCELLANEOUS ITEMS				
8.1	Maintenance Ladder			Car wheel mounted Free-standing
a)	Make		:	
b)	Material		:	
c)	Reference Standard		:	
d)	Height	m	:	
e)	Catalogue furnished ?		:	
8.2	Conduits			For use in all general plant area and bldg. For use in all chemical handling areas, Battery rooms etc.
a)	Make		:	
b)	Type/material		:	
c)	Reference Standard		:	
d)	Gauge upto 25mm dia		:	
e)	Gauge above 25mm dia		:	
f)	Catalogue furnished ?		:	
8.3	Junction Box			
a)	Make		:	
b)	Type/material		:	
c)	Reference Standard		:	
d)	Degree of protection Indoor/Outdoor		:	
e)	Catalogue furnished ?		:	
f)	Material thickness		:	
8.4	Terminal Block			
a)	Make		:	

11)

- b) Type :
- c) Reference Standard :
- d) Current Rating :
- e) Voltage grade :
- f) Catalogue furnished ? :

8.5 Wires (1 core)

- a) Make :
- b) Type :
- c) Reference Standard :
- d) Voltage grade :
- e) Wire Sizes 2.5 Sq.mm 10 Sq.mm
- f) Conductor
 - i) Material :
 - ii) No. & dia of wires/strands :
- g) Insulation
 - i) Material :
 - ii) Thickness mm :

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SECTION - 5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

PLEASE NOTE:

a) The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

Hence bidder shall ensure the completeness of their offer in this regard.

Please mark "YES" if the specified requirement is met or put a mark "NO" if the specified requirement is not met and give reason in column 5.

BHEL Enquiry no:

Bidder offer reference:

EQUIPMENT: Illumination System

Sl.no	Parameter	Data	Bidder's conformation	Reason for non-compliance
(1)	(2)	(3)	(4)	(5)
1.	Provision of illumination for specified areas as per spec.		YES / NO	
2.	Guaranteeing the illumination levels specified as per spec.		YES / NO	
3.	Type of lighting luminaries included as per spec.		YES / NO	
4.	Lighting DBs & LPs included as per spec.		YES / NO	
6.	Lighting poles included as per spec.		YES / NO	
7.	Sockets, Plugs & other items included as per spec.		YES / NO	
8.	ETC of Package included in the offer		YES / NO	
9.	Supply & ETC of all wires / Cables / earthing material required for the package other than the items supplied by BHEL included in the package.		YES / NO	
10.	ETC of BHEL supplied Cables included in the offer		YES / NO	
11.	ETC of BHEL supplied earthing strip included in the offer		YES / NO	
13.	Type and lumen output of lamps included in the offer are as per specification.		YES / NO	
14.	Whether any new item other than the BOQ given required to meet the specification requirement.		YES / NO	
15.	If new item is required whether these		YES / NO	

9)

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	are listed with quantities in the offer			
16.	Equipment included suitable for operation on voltage & frequency Variation limits specified in the specification without effecting their performance		YES / NO	
17.	Power factor of lamp circuit is as per specification		YES / NO	
18.	Fully filled in GTP enclosed		YES / NO	
20.	Auto switching arrangement for outdoor flood lighting / street lighting through Timer / Photo cell included		YES / NO	
21.	Spares included in the offer (a) Mandatory (b) Commissioning		YES / NO YES / NO	
22.	Activity Schedule enclosed		YES / NO	
23.	Type test reports	Type test reports furnished shall be in line with clause 1.5 (Section-1)	Yes	
24.	Type test	If type test reports are not acceptable to GSEC L/DCPL/BHEL then above tests shall be conducted by the bidder free of cost	Yes	
25.	Mandatory spares quoted in line with Annexure-1 (BOQ) of section-1	Yes	Yes/No	
26.	Bidder to confirm that it will offer approved make of components & fitments (ANNEXURE-4) at Contract stage. In case the offered make is not approved by the Customer, then alternate make shall be supplied without any commercial implication to BHEL.	Yes	Yes/No	

Bidder's

Sign :
Date :
Name :
Design :